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Initial Strategies for the Tactical Operations System (TOS) Support of the Command and Control Process

Volume 1: Overview of TOS Operations

by

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The impact of the Tactical Operations System (TOS) on the procedures, personnel, and skill requirements for affected staff elements at Army division, brigade, and battalion command posts is discussed. Changes to the current TOS design that would enhance its usefulness to staff users are identified and defined. The results of this research provide basic source material useful for determining TOS training requirements and providing the rationale for detailed investigation of the feasibility and

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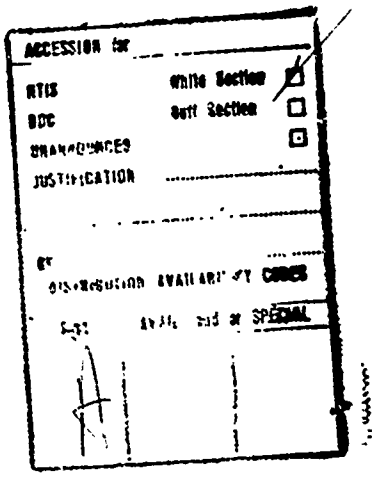

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FOREWORD

System Development Corporation (SDC) submits this document to the U. S. Army Research Institute for the Behavioral and Social Sciences (ARI) in accordance with contract number DAHC 19-77-C-0018, "Application of Human Factors Research to (1) Develop Training Objectives for Brigade Commanders and Brigade Command Groups and, (2) Optimize the Effectiveness of Command Posts at Division Level." Mr. Steven R. Stewart, ARI Field Unit - Leavenworth, was the Contracting Officer's Technical Representative.

The reader is cautioned to remember that at the time of this research the Tactical Operations System (TOS) design was at the preliminary specifications stage. This document, of necessity, addresses details associated with the TOS design at a point in time, specifically, 24 October 1977. As TOS evolves, much of this material will become obsolete.

The research was performed by SDC personnel at Fort Leavenworth, Kansas during the period 8 February 1977 - 7 February 1978. Mr. B. R. Modisette was the Project Manager and Mr. R. R. Michel and Mr. G. W. Stevens were project members. Mr. W. M. McGreer was a member for part of the project.

The documents produced for this project are:

TM-5958/000/00, "A Description of an Army Division Manual Tactical Operations Center Organization and Tasks," 12 September 1977.
TM-5958/001/00, "Tactical Organization and Tasks of the Intelligence (S2) and Operations (S3) Elements Within the Tactical Operations Centers of a Brigade and a Battalion," 21 October 1977.
TM-6008/000/00, "Research on Training for Brigade Command Groups: Factors Contributing to Unit Combat Readiness. Final Report," 7 February 1978.
TM-6008/001/00, "Training for Brigade Command Groups: Training Objectives and Strategies," 7 February 1978.
TM-6008/002/00, "A Training Feedback System for Brigade Command Groups," 7 February 1978.
TM-6009/000/00, "Initial Strategies for the Tactical Operations System (TOS) Support of the Command and Control Process. Final Report, Volume 1, Overview of TOS Operations," 7 February 1978.
TM-6009/001/00, "Initial Strategies for the Tactical Operations System (TOS) Support of the Command and Control Process. Final Report, Volume 2, Description of TOS Functions for Division Elements," 7 February 1978.
TM-6009/002/00, "Initial Strategies for the Tactical Operations System (TOS) Support of the Command and Control Process. Final Report, Volume 3, Description of TOS Functions at Brigade and Battalion," 7 February 1978.

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Investigated FORSCOM Division

The thirty-eight staff and element personnel who contributed their hospitality, time, and descriptions of their tactical operations.

The contributions of Mr. Paul E. McKeown, SDC, to the project were outstanding and deeply appreciated. Other SDC personnel contributing to the project were Mr. John E. Boydstun and Mr. John J. Necozzi.

EXECUTIVE SUMMARY

PURPOSE

One purpose of this project was to investigate the impact of the Tactical Operations System (TOS) on the procedures, personnel, and skill requirements for affected staff elements at army division, brigade, and battalion field command posts. A further purpose of the project was to identify and define, based on the staff functional analysis, changes to the current TOS design that would enhance its usefulness to staff users. The results of this research are intended to provide basic source material to be used in determining the TOS training requirements and to provide the rationale for detailed investigation of the feasibility and utility of proposed system enhancements.

METHODOLOGY

Project methodology consisted of gathering documented and empirical information on task performance without TOS and comparing these manual task requirements with TOS capabilities to develop, for each investigated staff element, a description of its projected operation under TOS. Empirical manual task data were gathered through structured interviews conducted at an active U. S. Army Forces Command (FORSCOM) division and involved army personnel currently assigned to the investigated staff elements. In addition to the interviews, command post exercises were observed. TOS system definition data were gathered through system documentation and informal and formal meetings with personnel from the Combined Arms Combat Developments Activity (CACDA) who are directly involved in developing the TOS system requirements. The definition used was that of 24 October 1977. Documentation of element operations under TOS and the TOS enhancement recommendations was performed by the project staff and does not necessarily represent the opinions of CACDA.

Twenty-two staff sections and elements at the division main command post, the division tactical command post, brigade command post, and battalion command post were investigated. Descriptions of the projected element operations under TOS for twenty of these elements are contained in the volumes of this final report. The remaining two investigated elements, the division signal security element and the division tactical air control party, were found to have no direct interaction with TOS and are not described in this report.

FINDINGS

TOS will have an impact on the performance of division functions which will vary from function to function. The major impact will be in the areas of intelligence and operations and lesser impact will occur in the personnel and logis-

tics functions. The analysis support appears to be the weakest of the capabilities supplied by TOS. While the software has the capability for organizing data for analysis, no algorithms are included to assist in performing the analyses. Recommendations for software enhancements and changes to the hardware configuration are documented.

TOS should improve the data handling, processing, and decision making of the division as a whole. Improvement iterations are expected after the system has been tested in an operational environment.

RECOMMENDATIONS FOR USING THIS REPORT AND FOR FURTHER STUDY

Use the information in this final report to assist in defining the training requirements for TOS. This documentation contains the probable uses of TOS for the investigated staff elements and the ways that TOS will affect the current operation of those elements. As such, it represents the most detailed information known to be available on TOS staff user requirements and procedures. The criticality and frequency estimates and the general procedures contained in the TOS assisted task descriptions provide source data for selecting tasks for training. The manning recommendations, assignments of positions to tasks, and recommendations concerning which positions should interact directly with TOS and which other positions should have knowledge of TOS operations, provide rationale that should be considered in determining the positions to be trained, the level of instruction required, the number of students, and the army schools affected. Training location decisions might be based in part on the frequency, criticality, coordination requirements, and procedural information contained in the individual TOS assisted task descriptions.

Use the information in this final report to assist in developing the standing operating procedures and organization and functions requirements for future tests of the TOS system. This documentation identifies the anticipated file use, coordination, and general procedures to be employed in using TOS within those investigated elements. Areas requiring the development of standing operating procedures are identified where possible.

Use the information in this final report when considering modifications to the current TOS design. A preliminary judgment concerning the benefits and general effects of proposed changes on the operation of various staff elements can be made by investigating the functional and procedural information contained in this final report.

Investigate the feasibility of TOS enhancement recommendations included in this final report. Recommendations for modifications and additions to the current TOS software and hardware design are contained in the TOS applications section and in various element descriptions throughout this report. The analysis of

TOS support of the investigated staff user functions and job requirements uncovered functional areas and specific operations which the current TOS design does not support but whose accomplishment could be enhanced through automatic data processing. The resulting recommendations require further investigation and testing to determine the degree to which they enhance the performance of users in the target population.

Expand the analysis to include elements and agencies not in this report. Due to time and manpower restraints, the project did not investigate division TOS users who are located outside of the primary command and control facilities. Under the current TOS hardware configuration, there will also be TOS consoles at the division artillery (DIVARTY), division engineer battalion, air defense artillery (ADA) battalion, aviation battalion, and division support command (DISCOM) locations. It is recommended that the operation and TOS usage of these organizations be investigated.

Update this report periodically to reflect changes in TOS configuration, TOS capabilities, and division staff oganizational changes. Modifications and more detail are being added to the TOS system description as the design phase nears completion. It is recommended that this document be updated as such information becomes available to increase its value as a reference source, not only for making training decisions, but also, for later development of user documentation. Several doctrinal reorganizations of the division staff are currently under study, such as, the combat electronic warfare intelligence (CEWI) battalion concept and the restructured division study, which will alter the assignment of TOS related tasks within the staff elements. These reorganizations should be included to complete the report.

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INTRODUCTION

BACKGROUND

The configuration and operation of division command posts called for by current doctrine represent an extension and refinement of doctrinal concepts which have been in existence for several hundred years. Traditionally, these methods of operation have been, in general, successful and, in some instances, highly successful or effective. Within the army today there is a growing concern that the traditional staff structure and operating procedures will not be effective on the modern battlefield unless information processing tools of an automated nature can be developed and used. The cause for this concern involves rapidly developing highly sophisticated data acquisition systems including new families of sensors, second and third generation signal intelligence equipment, and automated battlefield systems, such as the Tactical Fire Direction System (TACFIRE). Additionally, the anticipated pace of the battle and changing tactics necessitated by the introduction of more complex and effective weapons systems will require more complete, timely, and precise information on the disposition and status of both friendly and enemy forces.

Although the army recognized the problem as early as 1955, as evidenced by the antecedents of the TOS program which were largely exploratory and conceptual in nature, it was not until 1971 that a decision coordination paper was prepared and approved. It was at this time that the problem was given formal recognition and the army embarked on the major system acquisition process. The test bed version of the system, known as the Tactical Operations System, Operable Segment (TOS^2), served as the vehicle for accomplishing a combined force development test and experimentation (FDTE) and preliminary development test/operational test (DT/OT I) for the system from March through mid-July of 1977. The data produced from these tests provided the basis for refining the TOS software requirements and for development decisions on the program to be made by the army systems acquisition review council (ASARC) and the defense systems acquisition review council (DSARC) during the second quarter of Fiscal Year 1978. If these decisions are affirmative, the system will move into full scale engineering development, with the engineering prototype system scheduled to undergo DT/OT II testing in the 1979 to 1981 time frame. One prerequisite for a successful DT/OT II of the system will be a systematically developed and comprehensive training program. The requirement for such a comprehensive training program to be developed to support testing during this stage of the acquisition cycle and for the eventual fielding of the system is outlined in AR 1000-2.

One of the primary purposes of this project was to produce a solid conceptual framework that would outline from a systems context how TOS would be used to support staff operations within the division. Such a conceptual framework derived through a job task analytic procedure is a necessary first step in the overall training development sequence. Further elaboration of the major objectives of this project is provided below.

OBJECTIVES

This project had two main objectives. The first was to develop concepts for using TOS to assist in accomplishing critical functions, duties, and tasks that must be performed within those command and control elements of the division which will be affected by the introduction of the system. The concepts of use were developed for individual staff user positions within the various command and control elements. The project, in part, was designed to provide a fairly detailed conceptual system description. This foundation is needed by training developers to continue the analytical process to the next level of detail dealing with the behavior and skills associated with the operation, use, and repair of specific sets of hardware and software. Thus, this project provides the initial input necessary for the full scale development of TOS training materials to support the DT/OT II and the eventual fielding of the system.

Through the analytical effort involved in satisfying the first major objective of the project, it was possible to identify critical command and control duties and tasks that appeared impossible or nearly impossible to perform effectively given current manual procedures and existing and projected TOS software capabilities. Thus, identification of these shortfalls constituted the second major thrust of the project and they will provide the foci for future research efforts. The areas of weakness identified and tentative recommendations as to how the problem areas might be overcome are addressed throughout the remaining sections of the report.

SCOPE

This analytical work was focused on the staff user, the individual that must be cognizant of the TOS software applications as they relate to accomplishing his assigned tactical duties and responsibilities. Concentrating on the staff user was necessary because exact hardware and software specifications were not frozen at the time the project was initiated and they have not been, even at the time of this writing. It was not possible to focus on operator and maintenance functions, functions which are very much dependent on specific sets of hardware and software. It was possible to concentrate on the staff user, however, since the general specifications of the software, that portion of the system upon which the staff officer's ability to perform his assigned duties depends, were known and fairly firm at the time the project began. The detail addressed as to how the staff user will use TOS application software to accomplish his assigned duties and tasks was maximal, given the current level of specificity of the TOS applications software specifications and the state of their implementation.

The project embraced all affected echelons within the division, both tactical and main command posts at the division level as well as the brigade and battalion command posts. However, only the tasks and duties of personnel in elements/

sections judged through analysis to be the ones potentially most heavily impacted upon by the introduction of TOS were investigated. A listing of these elements at the various echelons is provided in a later section. Also, only tactical or combat related functions and tasks were investigated. Garrison duties of the elements analyzed were not considered.

METHOD

Selection of Elements to be Surveyed

Although TOS is being developed to support each of the coordinating staff members to greater or lesser extents, the primary thrust has been to develop supporting aids for the intelligence (G2) and operations (G3) coordinating staff sections. Even within these sections concentration of developmental effort has focused on selected elements, such as the G2 analysis and production element. Because of this and the amount of resources available, the project staff, both SDC and ARI, met with subject matter experts provided by the TOS System Manager's Office and jointly determined what sections and elements within the affected division echelons should be included in the investigation and which sections and elements of those surveyed should receive the most in-depth treatment. Table 1 shows what sections and elements were included in the project and provides an indication of the extent to which each was examined.

Preparation of Data Collection Forms

After decisions regarding what sections and elements should be included in the effort, prototype data collection forms were developed. The forms were designed to:

a. Record manual job task information and verify that the functions performed by the sections and elements within an operational division were the same or analogous to those contained in the standing operating procedures and organization and functions documents that represent current doctrine and which were used in the TOS DT/OT I. These documents developed for use in DT/OT I addressed only the broad functions performed by the sections and elements within the division. They did not specify what tasks individual staff personnel performed as input to those functions, information which is necessary for detailed training development. Thus, the major purpose of the data collection forms discussed here was to gather information about incumbent job tasks, the processes involved in their performance, and how task accomplishment contributed to the accomplishment of section and element functions.

b. Record for each incumbent position analyzed: who or what position serves as his direct supervisor, positions which he supervises, amount of supervision he gives and receives, unusual working conditions, and references available which provide details on his duty position in terms of job tasks and processes involved in their performance.

TABLE 1
Breakout of Elements and Sections Studied by Echelon

Division	Brigade	Battalion
Main Command Post		
G1 Element*		
G2 Element • Operations & Collection Management & Dissemination** • Analysis & Production** • Army Security Agency (ASA) Tactical Support** • Counterintelligence Control** • Signal Security[1] • Staff Weather*	S2 Element** (General)	S3 Element** (General)
G3 Element • Operations & Planning** • Fire Support** • Chemical** • Division Airspace Management (including Air Defense Artillery)* • Tactical Air Control Party[1]	S2 Element** (General)	S3 Element** (General)
G4 Element*		
Tactical Command Post		
G2 Element**		
G3 Element • Operations & Planning** • Fire Support* • Tactical Air Control Party (Fighter)*		

*Minor Examination
**Major Examination
[1]Data gathered for these elements indicated no direct TOS interaction and they have been dropped from any further element description.

c. Record for each task: the incumbent position(s) who perform the task, what inputs are used, what processes are involved in accomplishing the tasks, what outputs are produced, with what other positions was coordination necessary, and estimates of task criticality to successful performance of the section's on element's functions.

The data collection interview forms were pilot tested using staff and faculty members from the Command and General Staff College and military officers provided from the TOS Manager's Office. Six officers who rank from Major to Colonel served as pilot interviewees. Their comments resulted in several minor changes being made to the draft data collection forms. A copy of the revised forms used in this study is included as Appendix B.

Unit Surveyed

The manual operations source data contained in remaining sections of this report beyond that which was contained in the TOS DT/OT I documentation were obtained from the personnel of one FORSCOM division. A total of 38 division staff members were interviewed, representing personnel from each of the coordinating staff elements and sections shown in Table 1.

Data Collection Procedure

As a prelude to actual data collection activities, the ARI and SDC project staff and representatives from the TOS Manager's Office briefed the coordinating staff section and element chiefs, the affected special staff elements, and the division chief of staff. The subjects briefed included TOS and its current stage of development, the overall purpose of the project described herein and how it will support the continued development of TOS, and, finally, what was required of the division staff to successfully accomplish this project. After the briefing, the coordinating staff element and section chiefs and the chiefs of appropriate special staff elements were given copies of those portions of the TOS DT/OT I documentation which addressed their individual work areas. They were requested to study these materials and be prepared when the data collection team actually arrived to discuss whether or not the descriptions contained in the documents accurately reflected the major functions their section and element perform and, if not, how their functioning differs. Further, they were requested to identify individuals within their respective sections and elements whose job tasks were key to the successful accomplishment of the sections' and elements' functions. These key individuals plus the section and element chief would serve as the primary data source. A tentative interview schedule was coordinated with the G3 prior to the closure of this initial meeting.

Within two weeks after the initial visit, an SDC interview team, consisting of three members, returned to the division and remained there for a period of three weeks. As stated above, a total of 38 individuals were interviewed.

A great majority of the interviewees were section and element chiefs and the remainder were those selected by the section and element chief to discuss their own areas of specialized expertise. All interviewees responded to the items on the data collection form shown in Appendix B and were requested to keep their descriptions unclassified. It was felt that enough information of an unclassified nature could be obtained to make a fairly precise estimate of the potential impact of TOS on division operations.

General Analytical Approach

The interview results along with the TOS DT/OT I documentation provided the information necessary to develop detailed specification of how the investigated division sections and elements operate at an individual staff position level in the absence of automation assistance. The manual baselines produced for the division headquarters, both tactical and main command posts, and the brigade and battalion were published separately.[1] These documents provided the basis for entering into the next stage of the analysis which dealt with overlaying descriptions of existing and projected TOS software capabilities onto the manual baseline. The intent of this analysis was to identify who would be using the TOS applications, for what purpose(s) they would be used, how the incumbent's position could be changed as a function of introducing TOS, and what impact there might then be on section and element manning. The analysis also produced indications of what changes could be made in the current software requirements that would make them more beneficial to the staff and of areas where automation assistance ostensibly would be beneficial which heretofore had not been addressed or carefully examined. To accomplish this second phase of overlaying the software requirements onto the manual baseline, seven military officers who were very familiar with the capabilities of the TOS software, including the subset actually implemented in TOS[2] and that portion in conceptual definition stage, worked with the project staff for a total of approximately five weeks. Simultaneously, the group stepped through the detailed manual task and process descriptions and the capabilities of the TOS software. They thus identified those tasks were TOS could perform the required processes without human interaction, where the task processes would be TOS assisted, and, finally, those tasks where the processes will continue to be performed manually, given the

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[1] B. R. Modisette, R. R. Michel, Gordon W. Stevens, A Description of an Army Division Manual Tactical Operations Center Organization and Tasks (SDC TM-5958/000/00). Santa Monica, California: System Development Corporation, 12 September 1977; and B. R. Modisette, R. R. Michel, G. W. Stevens, Tactical Organization and Tasks of the Intelligence (S2) and Operations (S3) Elements Within the Tactical Operations Centers of a Brigade and a Battalion (SDC TM-5958/001/00). Santa Monica, California: System Development Corporation, 21 October 1977.

current TOS software definition. Definition of the TOS hardware and software configuration used as the basis for this comparison is contained in the next major section of this document.

The third and final phase of the effort consisted of analyzing the outputs of the second phase and integrating them into an overall concept of how TOS as currently defined could be used to assist in the accomplishment of required staff job tasks. Considered also were procedures for TOS system management and control which go beyond the capabilities of the software per se, but are necessary if the total system is to function effectively. The output of this third phase of the analysis is provided in the remaining sections of this report.

REPORT ORGANIZATION

The final report for the project is titled "Initial Strategies for Tactical Operations System (TOS) Support of the Command and Control Process." It has been prepared and documented in three separate volumes with these subtitles:

- Volume 1 - Overview of TOS Operations
- Volume 2 - Description of TOS Functions for Division Elements
- Volume 3 - Description of TOS Functions at Brigade and Battalion

The initial volume is intended to provide a succinct overview of the project and an overview of TOS applications for a division fielded with TOS. Subsequent volumes are intended to provide more specific details and explanations on how TOS might be applied at the division, brigade, and battalion levels.

Volume one is designed for a familiarization with the project and presenting an overview of its findings. The document presents an opening executive summary describing the basic purpose and methodology applied to the project and a general recommendations section to highlight the conclusions and recommendations resulting from the project. The introduction section of the volume presents an explanation of the project background, objectives, scope, methods, unit surveyed, data collection procedures, and general analytical approach. This is followed by a description of the TOS hardware equipment and configuration and the software functions that were overlaid on the manual operations data to determine the operations under TOS. Volume one concludes with a TOS applications section which outlines the operational and functional concepts providing the basis for integrating TOS into the division. It includes a summary of the division's missions and functions, the overall impact of TOS on the division, and comments and suggestions about the integration of TOS into the division. Volume one also contains Appendix A (references), Appendix B (data collection forms), and Appendix C (list of acronyms and abbreviations).

Volume two is organized to present detailed descriptions of how each investigated division level element will operate when equipped with TOS. Descriptions for those elements located in the division main command post appear first and are

followed by elements of the division tactical command post. Each element description contains the following sections:

- General statement - presents a general opening statement describing where the element is located, who supervises it, and its responsibilities.
- Mission - presents a brief statement of the general functions performed by the element.
- Overview of TOS operations - presents a summary of the projected effects of TOS on the functions and tasks performed by the element.
- Functions and tasks - begins with a task matrix which lists the element's functions and tasks and the duty positions which perform each function or task. The matrix also indicates whether task performance is TOS assisted or conducted manually. The task matrix is followed by individual descriptions of each function or task which the element performs including estimated frequency, task criticality, position(s) performing the task, task inputs, task outputs, coordination requirements, and special notes relating to the task. In the case of TOS assisted tasks, the description also includes man/machine interface requirements and a definition of how the task might be accomplished using TOS capabilities.
- Personnel - presents a comparison of doctrinal manning for a sustained manual operations and the anticipated similar manning requirements under TOS. The basic emphasis was on developing a sustained 24-hour shift operation. The general personnel description includes how the personnel are to be used and suggestions for adding or deleting crew personnel.
- Recommendations - presents suggestions for consideration in developing TOS operations for the element.

The element description, including all individual task descriptions, presents a reasonably clear picture of how TOS is envisioned to affect each investigated division element.

Volume three presents detailed descriptions of each of the brigade and battalion elements studied during this project. Brigade elements are described first, followed by those of the battalion. The element description format used for the division and described previously was used for the brigade and battalion element descriptions.

TOS DEFINITION

GENERAL

TOS will be a secure, militarized, automatic data processing system that will enable a commander and his staff to effectively integrate and employ battlefield resources. The system will consist of the automatic data processing equipment, computer programs, personnel, communications, and procedures required for performing the data management tasks of receiving, filtering, processing,

correlating, storing, displaying, and disseminating the information that supports the commander's decision-making requirements. TOS will provide computer-assisted command and control functions within echelons of a division, between divisions, between divisions and corps, and with other army tactical automated systems. Man and machine-readable messages will be used to transmit information, update data bases, retrieve information from a data base, and perform special processing of data within the data base.

The primary mission of TOS will be to provide in a timely manner to the commander and his staff information required for seeing the battlefield, making decisions to exploit enemy force weaknesses, and determining courses of action for the effective employment of friendly resources.

The following definition of TOS is as it existed on 24 October 1977. Subsequent changes have occurred which could not be incorporated in this document due to time constraints. In the process of accomplishing the objectives of the current project, recommendations concerning the hardware configuration and software applications were identified. These recommendations are addressed in subsequent parts of this document.

TOS HARDWARE COMPONENTS

TOS functions will be accomplished by using the following hardware components.

Division Computer Center (DCC)

The DCC provides the major computing capability in the division. It provides for maintenance of the data base, numerical calculations, filtering, correlation of information, generation of responses to queries, automated dissemination functions, and support of other required processes and algorithms. The DCC accepts messages from and relays and transmits messages to TOS users and interoperating systems.

Terminal Control Unit (TCU)

The TCU is a small scale computer system capable of storing messages and graphics data, prompting for message and graphics composition, and enabling the analysis consoles to interact with the DCC. The TCU is capable of communicating with the TOS input output devices and interactive display systems.

Analysis Console (AC)

The AC provides the user with the capability to have graphics and alphanumeric input and output with or without an illuminated paper map background and as hard-copy output. ACs are connected to a TCU and have a one color plasma display, a

keyboard, and a printer. The AC is capable of input and output in formatted or free text and provides the user the capability to review, store, manipulate, and disseminate data on request and automatically.

Interactive Display System (IDS)

The IDS is a computer-driven large screen display panel which permits the integration of tactical command and control data on a universal transverse mercator (UTM) map background and facilitates user interaction with the data base. It provides the user the capability to create new displays interactively, display information from the data base through direct communication with the DCC or indirectly through connection with a TCU, update the data base, and store and retrieve displays. The IDS has sufficient memory for storing the display symbology used in conjunction with standard military maps. Within the body of this report, the IDS is referred to as the large screen display device to avoid any reference to and individual manufacturer's product.

Input Output Device (IOD)

The IOD is used for the display of, and interactions with, computer stored data. It will be a small, transportable device capable of sending and receiving graphics and alphanumeric data with a TCU or DCC. The IOD is equipped with a one color plasma display, a keyboard, and a printer. For alphanumeric data, the IOD provides the user the capability to display, prompt message composition, edit messages, and input and output messages in formatted or free text. For graphics data, the IOD provides the user with the capability to create new displays interactively, display information from the data base through direct communication with the DCC or indirectly through connection with a TCU, update the data base, and store and retrieve displays. The IOD will have a memory sufficient to store display symbology for use with standard military maps. Within the body of this report, no distinction is made between the AC and the IOD. They are both referred to as TOS consoles.

TOS hardware components will be located at the division main command post, division tactical command post, brigade, battalion, cavalry squadron, division artillery, and division support command command posts, and the engineer, aviation, air defense artillery, and combat electronic warfare intelligence battalions. TOS hardware components will also be provided to other systems for which TOS interoperability is required.

The division tactical operations center, division tactical command post, brigade, and battalion elements addressed in this project and the hardware components allocated to them are: intelligence analysis and production (1 IDS, 1 TCU, 3 ACs, and 1 IOD); intelligence reconnaissance and surveillance (1 IOD); intelligence collection management and dissemination (1 IOD); G3 operations (1 IDS and 1 IOD); G3 plans (1 IOD); fire support element, G3 air, and DAME (1 IOD shared);

G1 and G4 (1 shared IOD); tactical command post elements (1 TCU, 2 ACs, 1 IOD, and 1 IDS); brigade command post elements (1 TCU, 2 ACs, and 1 IOD); battalion command post elements (1 IOD); and system control in the DCC (1 IOD). Figure 1 presents the system configuration for the employment of TOS as contained in the TOS required operational capability (ROC) document.

TOS SOFTWARE COMPONENTS

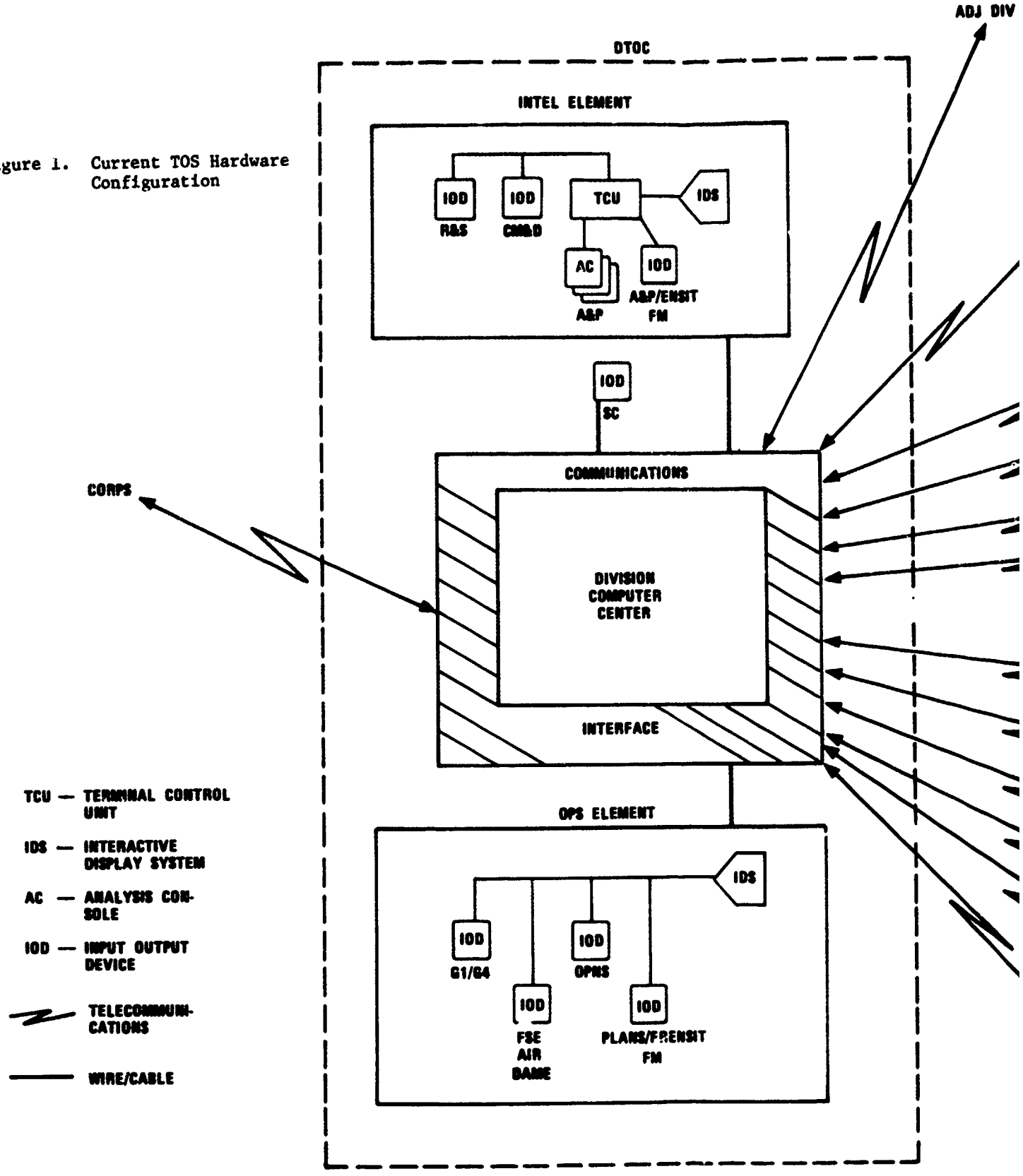
The following are included in TOS:

- Enemy situation (ENSIT) applications software
  - Enemy situation data
  - Enemy order of battle
  - Filter
  - Correlation
- Friendly situation (FRENSIT) applications software
  - Unit operations report
  - Task organization
  - Battlefield information report
  - Management of intelligence collection assets
  - Tactical dispositions
- Applications support (AS) software
  - Named area of interest
  - Staff working file
  - Terrain
  - Relay message
  - Center to center communications
  - Generalized on-line query
  - Distribution list
  - Standing request for information

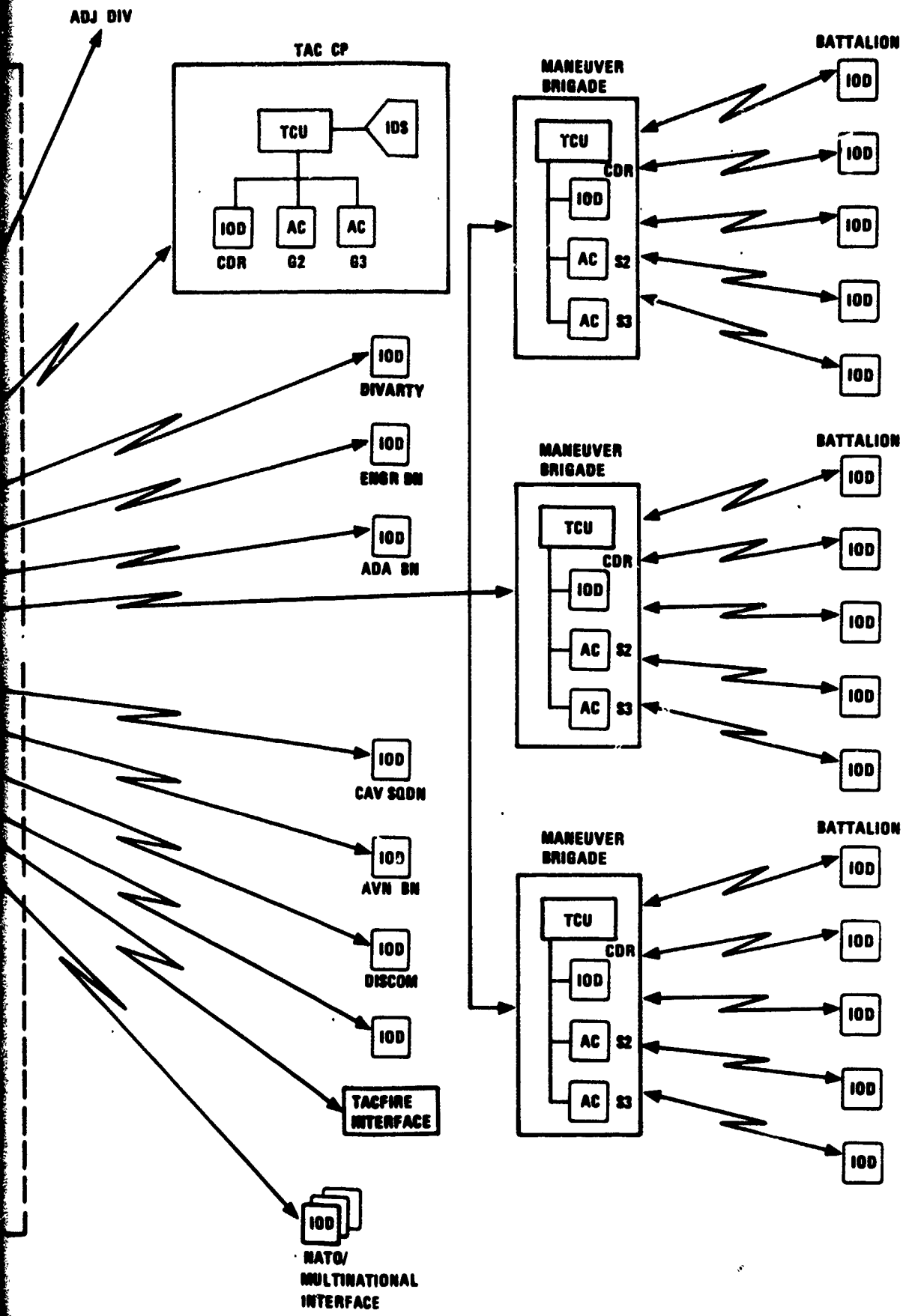
Enemy Situation Data

The enemy situation data (ESD) file contains unprocessed data and evaluated intelligence concerning enemy units, equipment, personnel, installations, field defenses, and activities. The application program associated with the file provides for collection, storage, dissemination, and selective retrieval of current enemy information. Other processes described later relate ESD file entries to other information available in the data base or put ESD file outputs in a more usable form. The major information elements or components of ESD file entries are: intelligence subject; combat activity; unit, element, equipment, and facility location; losses from friendly actions; unit or element movement; weapon system activities; potentiality of the above as targets; target identification; and target characteristics. Related to each ESD message is a list of users interested in the data contained in the message. User interest may be indicated in the following ways:

Figure 1. Current TOS Hardware Configuration



blank)


ADJ DIV
TAC CP
TCU
IDS
IOD
AC
AC
CDR
G2
G3
MANEUVER BRIGADE
TCU
CDR
IOD
AC S2
AC S3
BATTALION
IOD
IOD
IOD
IOD
IOD
IOD
DIVARTY
ENGR BN
ADA BN
CAV SQDN
AVN BN
DISCOM
TACFIRE INTERFACE
NATO/ MULTINATIONAL INTERFACE

- Users are specified as interested with the submission of the message
- An incoming ESD message satisfies the user criteria for a standing request for information
- A reviewer of the incoming message determines those interested in the message.

Users of enemy information may indicate their interest in messages as a means of retrieving data from the file. An enemy situation message that has no user interested in it is automatically purged from the data base.

All system users and collection agencies and sources may provide data for this application. ESD provides the basic intelligence reporting mechanism for system users and forms the basis for developing enemy order of battle, targeting, and other processed intelligence.

Enemy Order of Battle

The enemy order of battle (EOB) file contains processed and evaluated information about enemy units and the enemy force structure. The application program associated with the file provides the user with the capability to enter, maintain, selectively withdraw and process enemy force information, and to identify those elements of the enemy not yet located or whose location data is suspect. This application also provides the capability for keeping historical records of previous locations and activities of identified units. The major information elements of EOB file entries are: unit identification, location, subordination, activity, status, and combat effectiveness. In addition, other information known about the unit which friendly forces may use to advantage will be included in this file. The known structure of the enemy force is normally provided by higher headquarters. Other entries to this file will be made by analysts of the division A&P element based on analysis, correlation, and integration of intelligence from all sources.

Filter

The filter process provides an analyst the capability to select incoming ESD messages to be checked for redundancy with the current data base. Messages determined to be redundant are either presented to the analyst for his review for possible deletion, or are deleted automatically. The analyst defines the parameters of subject, activity, location, agency, and source by which incoming ESD messages are selected for the redundancy check. In addition, the analyst specifies the criteria by which a selected incoming message is determined to be redundant with a message already in the data base. The filter process enhances the capability of the ESD file manager to maintain the integrity of his file and serves to eliminate potential file saturation problems by preventing the entry of unneeded data. Filter criteria are established by the A&P element based on expected and actual flow of information into the intelligence element and evaluation of the trade-off between the need for detail and possible saturation of the data base.

Correlation

The correlation process provides analysts the capability to relate new input ESD messages to similar messages in the TOS data base. An analyst may specify correlation requirements in terms of subject, activity, source or agency, and a variable window in terms of time and distance. Information in the data base that satisfies the requirements will be provided automatically with the new input message and used in further analysis of the incoming message. The analysts in the A&P element normally establish criteria for correlation based on experience and the degree of closeness required to provide relevance to their analysis.

Center to Center Communications

The center to center communications process permits the central processor of a system to respond to requests for information from, and pass selected information to, the central processor of another system. This process may be established by the use of TOS query, standing request for information, or the distribution functions. Messages, summaries, and processed reports may be dispatched or requested. The requirements for passing information from lower units to higher headquarters are normally established by directive. Unit standing operating procedures will establish the requirements for other dissemination of data.

Generalized On-Line Query System (GOQS)

This retrieval language affords the TOS system user the capability to define retrieval parameters and report output format. The query may be executed immediately or stored for repeated future use. The find statement specifies the file set or data base to be searched. Retrieval parameters are specified in terms of field identifiers, relational operators, and data values. Print and display commands specify the output format and medium. The user is able to sort the output, sum numeric quantities, count the number of records meeting search criteria, establish a limit on the number of output pages, and perform periodic summaries.

Unit Operations Report

The unit operations report (UOR) process permits automatic record communication between the division and its subordinate units in the general area of mission related enemy activity, support, weather, terrain, and tactical activity. Provision is made for entry, dissemination, storage, and selected retrieval of UOR messages. This report is particularly well suited for entering data under the appropriate report subject where additional description or amplification, such as a warning or fragmentary order or weather forecasts, may be required.

Distribution List

The distribution list process provides selected users the capability to establish within the system one or more lists of distributees to whom a message is to be sent and to refer to this list by a shorthand code. This feature saves time when entering and transmitting messages and reduces errors. Distribution lists will normally be originated at division level and will be approved by the ENSIT and FRENSIT data base managers.

Task Organization

The task organization (TO) file contains information on the assignment and attachment of friendly force elements. The application program associated with the file provides operations planners the capability to enter, retrieve, and modify proposed changes to the task organization. This application will also store task organization changes planned for some future time and change the TO file at that time or on order. The major information elements in a TO file entry are: unit designation, echelon, unit type, parent unit, and type of subordination. The division operations (G3) element initializes the troop list entries. Changes to the data base are made by only those units controlling the units affected.

Battlefield Information Report

The battlefield information report (BIR) contains the status of major subordinate combat elements, brigades, maneuver battalions, and other designated units. Its contents may vary in accordance with the desires of the senior commander and the requirements of the situation. General information contents include location, activity, intensity of conflict, status of selected major systems, and the commander's perception of the situation. The report is transmitted at specified intervals to division main and tactical command posts.

Management of Intelligence Collection Assets

The management of intelligence collection assets function provides intelligence personnel with a set of files and processes that assist in the collection management processes. It also routes TOS standing requests for information established by other elements to the intelligence collection management and dissemination (CM&D) element to assure that collection requests are not duplicated and that tasking is sufficient to satisfy critical information requests. The following files comprise this application:

- Intelligence collection agency (ICA) file identifies each organic or attached collection agency and its available collection means
- Intelligence collection characteristics (ICC) file contains the range and degree of coverage for each collection means

- Intelligence collection requirements (ICR) file contains data specifying the information needed and reporting criteria
- Intelligence collection tasking (ICT) file identifies the specific tasking requirements assigned to each agency.

The intelligence collection agency file is normally initialized by agencies with a TOS input device and by the CM&D section for other agencies, and is updated as collection devices are added, deleted, or change locations. The collection characteristics file is initialized and updated in a similar manner. Collection requirements, if validated, may be processed into active collection tasking messages by the CM&D element. Tasking is normally provided as a product of tasking requirements, process algorithms, and CM&D element approval or modification of collection requests.

Tactical Dispositions

The tactical dispositions (TD) file contains geographic data relating to combat and combat support elements, service support locations, and certain tactical control measures. Input messages may be dispatched simultaneously to other interested users at higher, lower, and adjacent units. A planning work file application capable of storing operations plans for future use and recalling them from memory and distributing them to other users as required is provided. Entry to, or modification of, the planning work file may be made through keyboard message composition or through graphics displays. The major information and components in TD file entries are: unit identification, location, and type of location (command post, center of mass, objectives, blocking and delay position, boundaries, coordination points and lines, or assembly areas). The headquarters designating the control measure or position will normally be the source for input.

Named Area of Interest

The named area of interest (NAI) process supports users of both ENSIT and FRENSIT data bases. It provides users the capability of assigning a name to a geographical point, line, or area (circle or polygon). This permits the user in future queries or searches against that area to refer to it by given name instead of inputting several strings of coordinates. Named areas of interest are normally established by elements or echelons having the requirement to retrieve data on given parameters.

Staff Working File

The staff working file affords the TOS user with the capability to enter, process, store, and retrieve data which does not logically fit into other TOS files. It provides the user the flexibility to create new files to meet new or changing conditions. Access to a staff working file may be restricted to the individual creating it, or other users may be authorized to input or query the file.

Terrain

The terrain (TER) file contains terrain characteristics and the results of terrain analysis in terms of critical terrain, obstacles, observation, trafficability, and cover and concealment. These data will be available to all TOS staff users and will normally be output as graphics displays to supplement or highlight military map backgrounds. Basic terrain data and analysis will be provided by engineer topographical detachments in support of the division. Staff users may add other data to supplement this information.

Standing Request for Information

The standing request for information (SRI) file contains the criteria and dissemination instructions whereby messages arriving at the DCC are automatically selected for transmission to TOS users and other TOS centers. Individual SRIs have expiration times specified, insuring a periodic review of the ongoing need for the data. SRIs may be established for the following files: enemy situation data, enemy order of battle, task organization, tactical dispositions, battlefield information report, terrain, and unit operations report. Any TOS user having a definite need to receive messages as they occur may establish an SRI.

Relay Message

The relay message process provides the TOS user with the capability to transmit free text information to one or more designated recipients. The contents of the relay message are not added to any data base.

TOS COMMUNICATIONS

TOS is extremely dependent on communications for effective operation and will operate using multiple means of communications. The tactical communications system provides the necessary capabilities for transmitting, receiving, and interconnecting required for reliable and accurate exchange of data between the TOS functional segments. The specific communications network required will depend on the type and availability of means of communication and the number and locations of computer centers and user devices.

The available communications assets will greatly impact on the TOS system configuration. Staff users local to the DCC may be connected using field wire; users remote from the DCC may be connected using radio; and the DCC and supporting signal centers may be connected by multichannel radio, cable, or by FM radio. TOS will have the ability to reconfigure using alternative means of communications.

OVERVIEW OF TOS IMPACT ON THE DIVISION

PURPOSE

The purpose of this section is to outline the operational and functional concepts which provide the basis for integrating TOS into the division. It is assumed that the division is fully equipped with equipment and devices described in the TOS definition section of this report.

SCOPE

This section:

- Summarizes the mission and functions of the division
- Describes the overall impact of TOS on the division
- Provides comments and suggestions pertaining to TOS integration into the division.

MISSION OF THE DIVISION

The primary combat mission of the division as defined in FM 61-100 is "to destroy or capture enemy military forces and to secure or dominate key land areas and their populations and resources."[1] The division can also be employed in a variety of stability roles, such as advisory assistance and truce keeping, but TOS was designed and is intended to support the primary combat mission.

FUNCTIONS OF THE DIVISION

The basic command and control functions of a division are those of personnel, intelligence, operations, and logistics. Each of these major categories has within it a number of significant subordinate operational functions which are performed by the division and should be considered.

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[1] FM 61-100, The Division, Department of the Army, November 1968.

Personnel

Personnel functions are intended to keep the division informed on personnel strengths, the administrative situation, the current battle personnel needs, and changes in priority. The functions performed include:

- developing estimates
- recommending policies
- coordinating personnel activities
- maintaining unit strength status
- supervising personnel management.

Intelligence

Intelligence functions are intended to provide the division with the intelligence information on which to base current tactical decisions. The functions performed include:

- planning, collection management, analysis, production, and dissemination of analysis products
- planning and coordinating air and ground reconnaissance
- inputting to operational plans and orders
- coordinating counterintelligence
- coordinating HUMINT exploitation.

Operations

Operations functions are intended to support the division in controlling immediate combat operations and sustaining battle. The functions performed include:

- preparing operations plans
- maintaining an operations estimate
- preparing reports to higher headquarters
- coordinating tactical troop movements
- employing nuclear and chemical weapons
- conducting electronic warfare
- processing preplanned close air support requests.

Logistics

Logistics functions are intended to coordinate the logistics requirements with the tactical aspects of the battle. The functions performed include:

- coordinating tactical troop movements
- monitoring the logistic situation and capability
- planning supply, services, and maintenance
- monitoring medical activity
- coordinating tactical airlift requests for the division.

These functions are not intended to be all inclusive of those performed by the division staff. They are representative of the type of functions which TOS must assist. It is expected that many of the functions will remain manual and that others will benefit from TOS in varying degrees. The remainder of this document describes the impact of TOS on each of the functional areas in the division.

TOS IMPACT ON THE DIVISION

TOS has been overlaid on the division structure to provide basic computer capability down to battalion level. Units served include division, maneuver brigades and battalions, armored cavalry squadron, division support command, division artillery, aviation battalion, air defense artillery battalion, combat electronic warfare intelligence battalions, and the engineering battalion. It is also intended to interface with corps TOS, TACFIRE, NATO and other multinational and other new and evolving weapons, detection, and command and control systems. According to the TOS required operational capability document, TOS is expected to meet the following requirements:

- provide the flexibility to support command and staff functions
- provide computer assisted support to command and control processes
- exchange data with other tactical data systems
- provide continuity of operations under combat conditions
- conform to standards and criteria established by interservice documents.

TOS functioning within the division is intended to provide the capability to exchange data both internal and external to the division, build and maintain a computer data base, perform analysis support, and provide a display capability required to support division operations. Table 2 describes how the utility and applications of TOS capabilities varies from echelon to echelon and from function to function and the probable application of TOS throughout the division and within the main functions of personnel, intelligence, operations, and logistics. The general application of TOS to the division principal areas examined follows.

PERSONNEL

The personnel functions will be performed from a TOS console shared with logistics personnel in the main command post tactical operations center. The basic capabilities of data exchange, data management, analysis support, and graphics displays are available to support the function. This function will

TABLE 2.
TOS Capabilities Used by Functional Area

TOS Capabilities	Personnel				Intelligence			
	TAC	DIV	BDE*	BN*	TAC	DIV	BDE	BN
Data Exchange	X	X			X	X	X	X
Data Management	-	-			-	X	X	-
Analysis Support	-	X			X	X	X	-
Graphics Displays	-	-			X	X	X	-

TOS Capabilities	Operations				Logistics			
	TAC	DIV	BDE	BN	TAC	DIV	BDE*	BN*
Data Exchange	X	X	X	X	X	X		
Data Management	-	X	X	-	-	X		
Analysis Support	X	X	X	X	X	X		
Graphics Displays	X	X	X	-	X	X		

X = Application

- = No Application

* = Application Not Examined

have limited use for TOS because the data base includes little personnel information, few of the personnel functions are tactical in nature, and most of the tasks performed can be accomplished more efficiently and effectively through manual means. Although support analysis will not apply directly to personnel, the TOS data base information contained in the UOR, TD, BIR, TER, and staff working files may be accessed and assembled to support personnel tasks being accomplished within the division. The preparation of personnel estimates of the situation, estimates of sick and wounded rates for future operations, estimates of sick and wounded rates for POWs, and planning for the evacuation and hospitalization of casualties will continue to be performed manually. TOS will be used in coordinating personnel activities between the main and tactical command posts and the division support area and in coordinating unit and individual replacements within the division. For TOS to properly support this effort, personnel status staff working files will have to be generated, updated, and shared with those performing these tasks. It would appear that little benefit can be derived by the personnel section by using the basic graphics package provided by TOS. The utility or application of TOS for brigade and battalion personnel functions was not investigated as part of this study.

INTELLIGENCE

The intelligence functions will be performed from dedicated TOS consoles located in the tactical command post, main command post, and the brigade and battalion tactical operations centers. TOS capabilities of data exchange, data management, analysis support, and graphics displays are available to support the functions at each of the levels specified.

At the tactical command post, the TOS console will be used to receive combat information and intelligence messages, retrieve TOS graphics displays and digital data requested by the commander, and to retrieve and manipulate TOS data to aid in evaluating, analyzing, and interpreting combat information. Some intelligence information will still be received over the intelligence radio net, radio teletype, and by courier. These data will continue to be processed manually except that appropriate items might be displayed on the TOS large screen display device. Most coordination within the command post should be accomplished verbally or by using hardcopied or handwritten messages because this form of communications is most efficient due to the close proximity of personnel. The actual derivation of analysis conclusions will also be performed manually because TOS does not contain analysis routines to assist in this area. Updates to system files will not be accomplished at the tactical command post but will be passed verbally to the main command post. Control of the content of analysis product files should be under the control of one location to avoid confusion and possible contradictions.

Within the division main command post, the intelligence functions are diversified and performed by several staff sections. The intelligence operations function will use TOS primarily to keep abreast of the current situation. Preparation of the intelligence annex will require gathering of enemy situation and terrain data from TOS files. Supervising intelligence dissemination, coordinating the use of intelligence collection assets, and determining intelligence needs will require access to TOS graphics displays and file data. Preparation of formal division staff briefings will require the creation of graphics displays as well as the gathering of current situation data.

Some operations functions will remain manual after TOS is implemented. Administrative functions of maintaining the classified document log, maintaining personnel and equipment schedules, and maintaining command post access rosters may lend themselves to TOS file storage, but TOS is intended to support tactical operations and not administrative functions that could consume needed space and computing power because of its size and free text nature. Radio net intelligence will also continue to be processed manually although some data may require entry in the appropriate TOS files. Other operations functions will require face to face coordination and not use TOS. These include coordinating with operations personnel on matters such as operations security and electronic warfare plans, and emphasizing the importance of critical intelligence messages and products. Certain intelligence collection management functions performed early in the premission stages of collection planning will not be directly supported by TOS. They include developing the mission essential elements of information (EEI) and other information requirements (OIR), establishing intelligence indicators, and determining the priority and reporting time limits for intelligence data collection.

The intelligence analysis and production function will be performed from the all source intelligence center using every TOS capability. TOS will be used to store combat information. Maneuver units and collection agencies will be able to access and enter combat information directly into the TOS enemy situation data file. TOS features of query, filter, and correlation will be used to confirm, eliminate, correlate, and organize the combat intelligence into a form more suitable for analysis. Terrain analysis will be performed using terrain feature information supplied primarily by division and corps engineers. The data will be used to create TOS graphics terrain displays showing ostacles, key terrain, observation and fire, cover and concealment, and other terrain features. These data, augmented with other information such as the enemy order of battle, can be used to determine the possible enemy avenues of approach. The terrain data also has utility for operations personnel in developing courses of action and tactical maneuvers and for logistics personnel in developing main supply routes and locating depots.

The enemy order of battle analysis will be developed using TOS capabilities. Enemy situation data can be used to assist in determining enemy unit identification, composition, disposition, and strength. Known enemy order of battle data can be displayed and current location information can be compared with historical display records to aid in locating and identifying units. TOS graphics templates that depict the doctrinal arrangement of enemy units with some adjustments for terrain and weather can also be compared with the current enemy disposition to assist in determining the enemy's course of action. Enemy situation, terrain, and order of battle files can be used in conducting target analysis. TOS analysis support capabilities of query, SRJ, and correlation may be used to retrieve and assemble TOS file data into appropriate displays to aid in determining the most likely locations of enemy facilities such as command posts, supply areas, and artillery batteries. Analysis results will be stored and disseminated using TOS. Results of terrain, enemy order of battle, and other important analysis conclusions will be created, stored, and distributed by enemy situation or relay message. Display files may also be created and shared with the functions needing or requiring processed intelligence information.

The enemy situation, order of battle, and terrain files will require management. Management of the order of battle file will involve only deleting historical records no longer needed. Terrain features no longer in the division's area of operation will require purging. The enemy situation file will grow to a larger size than any other TOS file and will have to be closely supervised to avoid system data overloads. Automatic purge criteria to delete enemy situation entries based on age and, within age, on message content features such as source and subject must be established and maintained to control the file. Threshold indicators to warn of critical file size will be used to initiate immediate file purging to maintain an acceptable size.

The intelligence reconnaissance and surveillance function will use TOS primarily to process requests for preplanned air reconnaissance flights and to monitor ground reconnaissance and surveillance activities. Intelligence collection tasking messages will be processed to determine if the information required has been collected or is being collected by an already approved mission. TOS file data might be used to make this determination. Approved air reconnaissance missions might be file loaded to assist in deciding the acceptability of new air reconnaissance requests by determining if already approved flights match the essential characteristics of any new requests. In-flight air reconnaissance reports will be received over the TACP radio net and inserted into the enemy situation file for dissemination to TOS users. The status of air reconnaissance sorties and the current location and status of corps long range reconnaissance patrols (LRRPs) operating within the division's area of interest also need to be identified and loaded into the data base for the intelligence collection management function. Coordinating air reconnaissance mission airspace with the DAME will be accomplished without TOS support because the interchange will be faster and more flexible if accomplished by voice. Operations order R&S annex preparation will also not involve TOS interaction.

The Army Security Agency functions will use TOS to receive intelligence collection tasking messages which will be translated into specific SIGINT indicators to be used in tasking ASA field teams. The TOS console graphics displays of enemy and friendly unit locations and significant events will be used to keep abreast of the enemy and friendly situation. Knowledge of the current situation derived from these displays and other file information can also be used to formulate ASA field team tasking. TOS files will be searched for data from other sources that can be used to substantiate and analyze incoming ASA field team reports. TOS data might also be used to help in determining if the enemy is employing new EW or SIGINT equipment or tactics. TOS will be used to keep abreast of the current situation in order to assist in developing EW mission recommendations. TOS will not be used to prepare or transmit EW plans and meaconing, intrusion, jamming, and interference (MIJI) reports because of their length. TOS is not expected to be used in coordinating EW missions and operations because this coordination requires the flexibility of verbal communications. TOS is not expected to be used to process or evaluate incoming MIJI reports.

The counterintelligence (CI) function will use the TOS console to receive tasking collection messages which, if appropriate, are passed to CI field teams via non-TOS communications. TOS file data might be used in analyzing the enemy's intelligence collection activities. Intelligence files could be queried to retrieve the locations of enemy and friendly units and of terrain features such as key terrain, trafficability, barriers, and cover and concealment. These data could then be used to build graphics displays as aids in determining patterns of collection, sabotage and subversion activities, possible routes for enemy patrol infiltration, location and coverage of enemy electromagnetic collection devices, and routes and timing of past enemy ground reconnaissance patrols and aerial reconnaissance flights. The analysis of these and other data will help determine what the enemy is capable of collecting; the most probable future enemy collection, sabotage, and subversion activities; and what the enemy probably knows about us from their current and post collection activities. TOS will not be used for direct interaction with CI field teams or to develop or transmit the CI annex of the operations order. TOS will not be used in the actual planning of psychological or cover and deception operations because such planning requires the flexibility of verbal interactions.

The signal security function involves monitoring friendly non-secure communications to ascertain what information is being passed that might be of use to the enemy. TOS communications are over secure channels and not subject to monitoring; therefore, no additional data will be presented concerning this function throughout the remainder of the document.

The performance of the intelligence functions at brigade and battalion will be somewhat similar. The TOS consoles at both locations will be used to receive intelligence collection tasking and to input intelligence collection requirements. Brigade and battalion will be expected to query division staff files

to obtain the latest weather, terrain, and enemy situation summary data and projections needed to support their specific requirements, if such data is maintained at division. They will establish SRIs against the enemy situation, order of battle, and terrain files. TOS information can be disseminated within the brigade tactical operations center by message transfer to another console, hardcopy, TOS graphics displays, verbal exchange, and manual entry on a large scale acetate situation map. Dissemination within the battalion tactical operations center will be limited to hardcopy, verbal exchange, and the acetate situation map. Both tactical operations centers will probably continue to maintain acetate situation maps because neither has access to a large screen display device and the TOS console display area is too small to be continually referenced by all headquarters personnel. It may be useful for brigade, but not for battalion, to maintain a TOS graphics display of the enemy order of battle entries that are in the brigade's area of interest. The display could be maintained on the commander's console and used as the most up-to-date picture of the division's estimate of the enemy order of battle. Battalions are not expected to be able to use TOS graphics at all due to limited console accessibility. The brigade will have a hierarchical review capability to process any battalion input messages prior to their entry into the TOS system for final processing. This permits the brigade to filter out redundant, unnecessary, and inefficient battalion messages and requests and thereby reduce the probability of system overload. TOS indicators will have to be set specifying the types of battalion messages to be reviewed. These indicators will be subject to change to account for changing mission requirements. Reviewed messages may be deleted, modified, or transmitted to division without change. Battalion messages not reviewed will still be hardcopied at brigade. Brigade will process division intelligence collection tasking messages, determine which battalions can collect the information, and retransmit it to the appropriate battalions. The brigade will also submit intelligence collection requests via TOS to the division when brigade/battalion information needs cannot be readily collected by battalion or brigade assets. Performing intelligence analysis using the TOS data base will be limited at brigade and almost non-existent at battalion. Brigade manning precludes extensive analysis, but some limited analysis might be required if the data needed were time critical and analysis from higher headquarters was not forthcoming. Brigade and battalion might use division-defined TOS staff working files to identify and load their preplanned air reconnaissance requests. Battalion entries would first be inserted into the file and then rolled up by brigade to present the total brigade requirements for division review. The same procedure might be used for rolling up daily ground reconnaissance plans.

The performance of many of the brigade and battalion functions will not be affected by TOS. Functions in this category are: battalion communications with subordinate units will not involve TOS, battalion intelligence reporting to brigade can still come by radio net because only one TOS console exists at battalion and must be shared among battalion elements, battalion/brigade enemy situation displays will continue to be maintained manually due to the lack of a large screen display device, battalion/brigade operations order preparation will be manual, battalion/brigade handling of prisoners of war, operations

security and planning, cover and deception, and psychological warfare operations will also be handled manually.

OPERATIONS

The operations functions will be performed from dedicated TOS consoles located in the tactical command post, main command post, and the brigade and battalion tactical operations centers. TOS capabilities of data exchange, data management, analysis support, and graphics display are available to support the functions performed at each of the levels specified.

At the tactical command post, the TOS console will be used in developing the friendly situation, unit status, and operations estimate; controlling the maneuvering forces; and supervising the execution of operations in compliance with the commander's concepts and decisions. Friendly situation data will be extracted from the files and manipulated, using the TOS console, into appropriate displays describing the status and condition of subordinate units. Supportive displays presenting additional information of interest to the commander will also be developed, stored, and available on demand. Task organizations developed to support the maneuvering forces can also be extracted, presented, and reviewed as part of the situational data. Data received over the division command FM net can also be processed and used to augment TOS data in assembling the total situation summary. The TOS data base will be used to assemble and present an overall operations estimate for the commander. The major input source for developing this estimate will be the battlefield information reports submitted by brigades and battalions. Brigades and battalions will input periodic reports describing the current situation and status of friendly battle elements. Critical situation reports as required will be submitted to augment routine reports. Generally, the reports will reflect intensity of the situation, the relative combat strength of the unit, the status of supplies and communications, and the unit commander's personal overall assessment of his situation. These data will logically be augmented by significant events provided over the division command FM net and TOS data base information contained in displays. Free text summaries will be added to complete the operations estimate required by the commander or as stated in the standing operating procedures. Supportive courses of action can also be prepared and presented along with the estimate. The course of action should include: the type of action to be taken, time the action will begin or be completed, location of the action, use of available means, and purpose of the action. Changing tactical requirements needed to support the maneuvering plan, task organization, fire support, or engineering support will be detected by careful monitoring of corps and division command FM nets, TOS relay messages, and TOS situation displays. As tactical changes are identified, they need to be assessed in terms of criticality and developed into appropriate courses of action. Approved plans must be generated into fragmentary orders, modified operations overlays, or updated TOS files necessary to implement the approved

plan. Administrative processing of such plans can be accomplished at the main command post to prevent overloading the tactical command post. The commander will be apprised of all significant operations activities or events occurring in the division using the large screen display capability of TOS. Briefing areas include corps mission, division mission, covering force, division artillery operations, tactical air support, engineering, signal, and future operations. For each of these areas, the data base files will be screened and the data selected will be formed into TOS free text or display files from which the commander can be apprised of tactical operations. TOS will not be used to issue commander's concepts or decisions, recommend allocation of additional resources, plan tactical command post security, or conduct command FM net operations. These functions more readily lend themselves to manual operations.

Fire support operations will be conducted using TOS in the tactical command post. The performance of fire support functions will, however, be hampered because no TOS console has been assigned. Computer access must out of necessity be shared with intelligence or operations on an as available basis. Contact with division artillery will also be hampered because no TACFIRE terminal has been provided. Tactical fire situations within the division will be monitored by using TOS to access and review all situation displays, target files, vulnerability analyses, and fire plans developed and stored in TOS by the division main command post fire support element. Data obtained will be used to advise the commander on all matters pertaining to fire support operations. TOS will be used to monitor all fire support unit status. This can be accomplished through the use of prestored queries against the tactical dispositions, task organizations, battlefield report, and unit operations report files, or by reviewing fire support files of the main command post established for basically the same reasons. The principal fire support function of the tactical command post is the evaluation and coordination of immediate requests for fire support. This function will continue to be a manual process of receiving and processing fire requests on the command FM net. Situational TOS data may, however, provide the necessary background information for evaluating and developing a suitable response to the immediate request.

The main command post will use TOS to monitor combat operations and develop and coordinate detailed tactical planning. The overall discussion of operations at the main command post must include those functions performed by the operations, fire support, nuclear-biological-chemical, tactical air control, and division air space management sections.

Operations will use TOS to extract enemy and friendly situation data and planning guidance from the data base to generate a subset of the division operations order. The subset to be produced has been defined as the first five basic paragraphs of the order and the operations overlay. This function will utilize the basic TOS capabilities of file access, file update, graphics, and data transfer. TOS will also allow planners to readily prepare and issue fragmentary changes to the order using the graphics and free text file capabilities. It

is anticipated that both types of orders will use the distribution capability of TOS to transmit to all addressees simultaneously.

Tactical planners will use TOS to develop, on console, future courses of action to satisfy the commander's guidance or for probable future corps missions. Graphically developed courses of action may be assembled and stored in planning files and briefed to the commander using the large screen display system. Graphics and free text capabilities will be invaluable in generating and storing courses of action to different division situations. Once approved, they may be easily accessed and disseminated in the same manner as the operations order.

Operations will use TOS to maintain a current estimate by querying and establishing SRIs against the data base. Assembled data can be organized graphically to include enemy and friendly front line traces, boundaries of all echelons, command post locations, tactical maneuvering positions, nuclear and chemical strikes, and key barriers and obstacles. Additional data may be developed in display files and overlaid with these data to accommodate the commander's desires. This function, if appropriately handled, should provide the commander adequate surveillance over the battlefield, which is a prerequisite for the conduct of operations. Theoretically, the TOS center-to-center computer capability should eliminate most existing corps reporting requirements for data resident in the files. For data not normally resident in the files, the report can be developed manually in a staff working file and processed through TOS to corps.

Task organization generation is a capability of TOS used to input, maintain, and output data on a unit, its subordinate unit task organization, and its task force organization. The basic troop list should be preloaded into the system software thereby requiring only the entry of non-organic corps units or other units assigned or attached since the troop list was loaded. Each echelon will be responsible for the maintenance and accuracy of its unit file. Task organization changes may be loaded to be effective immediately or put in a pending status if the change is not to be effective within the next 30 minutes. The task organization changes will be used by operations to report and record changes in command relationships and support missions of division units as required by current operations.

Preplanned air support requests can be processed and rolled up using the TOS staff working file capability. Brigades will be responsible for rolling up battalion and brigade requests into one prioritized list in a division established file. Division will review, modify, and coordinate the requests with corps. Subsequent approvals and disapprovals will be coordinated down the channel in a similar manner to all echelons. TOS assistance should considerably reduce the processing time and subsequently increase the validity of target selection.

TOS will provide the basic capability to handle routine dissemination functions required of operations. This might include, but is not limited to, accomplishing required internal distribution, fragmentary orders, warning orders, strike warnings, selective publications and reports, and maintaining a log of activities or events. The majority of these activities can be accomplished using the free text or graphics capabilities of TOS. Although TOS is not intended to be a communications device, these data may be transmitted to the required addressees by distribution list or by specifying addresses. Operations data base management is a higher priority administrative function which will be accomplished using TOS to manage the FRENSIT data base. Many functions will still be accomplished manually. Most notable of these are developing operations order annexes, processing command net FM data, processing immediate air requests, and preparing the operations journal.

The fire support functions of the main command post will be accomplished using the TOS console and TACFIRE terminal. TOS will provide fire support personnel with all target intelligence data developed by the G2 A&P element and automatically enter these data in the artillery target intelligence file of TACFIRE. Targets not qualifying for DIVARTY engagement will be passed to the division fire support personnel for additional coordination with operations, tactical air support, or corps for further processing. Fire support personnel will be responsible for developing and loading fire support coordination measures in the files, such as the fire coordination line. The fire coordination line would be regenerated using the TOS capabilities each time a significant shift in the tactical situation occurs. After development, the new coordination line would be inserted into the file and transmitted to all appropriate addressees. The overall fire support situation display can be developed with TOS to describe current artillery operations within the division. The basic display permits monitoring of current operations and provides the data for briefing senior officers on-console or with the large screen display. Lesser tasks of target overlay and task organization development can also be TOS supported. The major fire support tasks of conventional and nuclear target analysis will be performed through basic tasking of the TACFIRE system. Inputs to and outputs from TACFIRE will be accomplished through the TACFIRE terminal. This interface will also permit fire support personnel to conduct fire planning and vulnerability analyses as required. The only basic manual function remaining in fire support is the development of the fire support annex for the operations order.

Nuclear, biological, and chemical functions will be performed from the TOS console supporting fire direction. NBC will jointly process all target intelligence with fire support and maintain a target file of all qualified NBC targets. When required, the target file may be accessed to develop a target base or list for TACFIRE chemical targeting analysis. Analysis results provided by TACFIRE may then be used to brief operations on the overall impact of target selection, weapons applications, and friendly hazards based upon the plan. Nuclear and chemical warning messages can be generated for fire missions assigned to TACFIRE and provided to the division via the TACFIRE terminal.

TACFIRE data must be reformatted for transmission within the division. The relay message capability of TOS may be used to transmit this message to all subscribers or it can be processed by command FM net as it currently is. Vulnerability analysis will be accomplished through TACFIRE tasking. Outputs can be summarized and assembled into a TOS display to portray the weapons impact on maneuvering forces. The TOS-TACFIRE support should eliminate the requirement to perform target analysis and permit personnel to spend more time analyzing effects on friendly forces and impact on the mission.

Initial fallout processing will be accomplished by tasking TACFIRE through the use of the NBC message formats. TACFIRE generated fallout and strike warning data will be provided to the division via the TACFIRE terminal. The predicted fallout and strike warning data will have to be reformatted into the appropriate division formats and loaded into TOS for recording and transmission to all echelons. The actual radiation levels will be calculated by displaying lower echelon radiation dose rate readings graphically to develop the required radiation contour data for the division. Contour data may then be converted to the appropriate NBC format and transmitted by TOS to all appropriate subscribers. These data will be shared with operations to determine how long troops can conduct operations in a given area and to prescribe what precautionary measures need to be instituted. Division NBC will establish and maintain a radiation exposure file which will include units down to and including battalions. Battalions and separate units will be required to maintain their own radiation exposure files and to report battalion radiation status category and average dose rate. This file may then be monitored by division to establish radiation exposure guides, degrees of risk, and composition of task forces for missions requiring radiation exposure. Every major NBC function will be provided with either TACFIRE or TOS support. Only those functions of division coordination and record keeping will remain basically manual.

The division airspace management element (DAME) function will use TOS to aid in identifying and resolving potential conflicts in the use of division airspace within the area of operations. The DAME will use TOS for developing and disseminating airspace control and coordinating procedures for use within the division. Flight corridors, avenues of approach, and minimum risk routes for aircraft will be developed graphically and stored in system files for future access and transmission. The storage of DAME data should be consistent with general file requirements and be limited to data requiring high visibility, frequent updating, and wide dissemination within the division and external command echelons having access to the TOS data base. ADA and aviation status will be maintained and disseminated without TOS support. Coordinating the use of aircraft for combat support will also be accomplished faster and with the needed flexibility by using voice communications. The aviation and airspace annex to division operations orders will be prepared manually, thereby saving time and computer storage for needed tactical applications.

The tactical air control (TACP) function within operations will continue to be performed manually with no direct support from TOS.

The division computer center (DDC) has the overall responsibility for TOS computer center installation and displacement, computer system configuration, and maintenance of the overall effectiveness of the TOS computer operations. Disassembling and reassembling the computer center at a new location requires an assortment of manual and TOS support. The principal manual functions are those related to preparing and moving the equipment, securing the equipment at the new location, and physically connecting power and communications with the DCC. Once power is applied to the system, TOS operating system software will be used to initialize system operations and perform system checks to ensure proper operation. Coordination with the data base managers will establish the current requirement for system subscribers and their status, including console assignments, originator codes, file sizes, and file access keys. The DCC section will determine when the system is ready to accept subscribers and will issue the order to transmit the "on the air" message. The DCC section will ensure that all security matters and practices are initiated and adhered to. They will conduct all computer system fault detection and fault isolation routines using TOS capabilities for all programmed and emergency maintenance periods. All system maintenance panels, control units, and TOS displays will be monitored and problems reported to ensure a current operational estimate of the system status and capability. DCC personnel will coordinate with data base managers to ensure that the operational requirements of the system are being satisfied. They will dynamically reconfigure the system as the need arises, reallocate file space to meet emergency requirements, prevent unauthorized access to the system, and attempt to adapt the system to the needs of the users.

The functions performed by TOS at the brigade and battalion level are similar, but the greater capability exists at brigade. Battalion has only one TOS console on which all staff inputs and outputs have to be shared. Both echelons will be able to receive, request, maintain, and present information concerning their tactical situation. Brigade and battalion will be able to use TOS to develop situational data although the use of TOS graphics for situational displays would appear impractical due to console display size and no large screen access. Maintenance and updating of the situational display for brigade and battalion can best be accomplished manually using TOS supplied data. Brigade and battalion will both be able to access and generate close air support and tactical airlift requests for their respective areas using division established files. The brigade will be able to generate courses of action graphically in response to tactical needs. These display files may be stored, displayed, and transmitted to battalions simultaneously should the need arise. This capability is not expected to be exercised frequently at battalion because of the one console capability. The brigade will be able to use the TOS data base to extract the essential elements necessary to construct the brigade portion of the division operations order. It is expected that the brigade will augment

the division order and overlay by analyzing the enemy indicators and avenues of approach to develop the task organization, tactical dispositions, and course of action which can best satisfy brigade objectives. When planning has been approved, TOS graphics may be used to create a brigade overlay which should describe the basic boundaries, objectives, coordination points, and phase lines developed to achieve the objectives. The brigade overlay may then be automatically distributed to battalion for review and amplification. Battalions will probably not use TOS for operations order planning due to the single console and because they have no way to retransmit TOS data to companies who will not be TOS-equipped. The other basic functions of the brigade and battalions,such as coordinating tactical operations center operations, preparing for future operations, requesting immediate air support, and monitoring FM command net operations, will remain manual operations.

LOGISTICS

The division logistics function will be performed from a TOS console shared with the personnel function in the main command post tactical operations center. The basic capabilities of data exchange, data management, analysis support, and graphics displays are available to support the function. Paragraph 4 of the division operations order will be generated using the TOS graphics capability, but any required logistical annex to the order will be prepared manually to save time and computer storage space needed for tactical purposes. The system graphics capability will be used to display significant logistical events for briefing the commander on the large screen display. Graphics will also be used to aid in generating the main supply route and supply points to support the operations order. Graphics displays showing obstacles, key terrain, observation and fire, roads, rivers, air strips, and friendly and enemy unit locations will be used to assist in determining the main supply route and supply points. Once developed, data points will be stored in the files for future reference. The TOS graphics capability will also be used to help coordinate recommended changes to the division rear boundary. The proposed boundary will be displayed on the large screen and coordinated with operations and the chief of staff. Approved boundary changes will be reported to corps for integration into corps boundaries. The updated boundary will also be loaded in the appropriate FRENSIT file. Area damage control, division movement activities, and maintaining status of supplies, vehicles, and equipment necessary for the accomplishment of the mission will continue to be basically manual. There is little or no support analysis performed to satisfy the logistical function. Data can be gathered and organized by TOS but no algorithms are provided to perform the statistical analysis requirements of logistics. Logistics functions below division were not examined.

SUMMARY

TOS will have a major impact on the conduct of division functions which will vary from function to function. The major impact will occur in the areas of intelligence and operations, with lesser impacts in the personnel and logistics functions. The analysis support appears to be the weakest of the capabilities supplied by TOS. TOS software has the data manipulation capability for organizing data for analysis, but no algorithms exist to assist in performing the actual analysis. Some examples of analysis areas where algorithms could be applied are enemy activity pattern analysis, enemy order of battle analysis, movement analysis, and combat power analysis. TOS should improve the data handling, processing, and decision making of the division as a whole. Iterations to improve the system can better be determined, developed, and installed after the system has been fielded and tested.

SUGGESTIONS AND RECOMMENDATIONS FOR DIVISION TOS INTEGRATION

The comments and suggestions in this section concerning TOS integration into the division structure are based upon the examination of an active division and how it conducts its functions in the current manual configuration compared with the TOS system as it is presently conceived in terms of organization, equipment, and software. These suggestions and comments are intended to be of a system nature although they may overlap suggestions and comments made later in the descriptions of individual division elements. System suggestions or comments are made to coincide with the main areas of data exchange, data management, analysis support, and graphics.

DATA EXCHANGE

Develop a software distribution matrix that will automatically distribute TOS messages based on specified message characteristics. Under the current TOS design, a message originator designates the message addressees either by entering the code name for each desired addressee or by entering a single value code that represents a discrete operator-created "distribution list" of addressees. It is recommended that the feasibility of developing a software distribution matrix that would automatically distribute messages to a standard list of users without operator designation be investigated.

The distribution matrix might contain the message characteristic or combination of characteristics such as type, subject, activity, or source for each category of messages having a unique distribution. The standard addressees would be identified for each message category. Messages input to the system, unless otherwise designated, would be compared to this matrix and automatically be distributed to the associated addressees. It is recommended that a message originator be able to default to this automatic distribution simply by not

entering any addressees. He should further be able to add or delete from this distribution, perhaps by entering a "+" or "-" followed by the applicable addressees. He could override automatic distribution by entering his own addressees. Also, every message generated should contain the list of its automatically determined addressees allowing any recipient to add to that list and retransmit to additional recipients. The matrix would be capable of being updated by adding, deleting, or modifying any item in a message distribution entry or by adding or deleting entire entries. Maintenance of the matrix during mission conduct would be centralized either under the system controller or under the ENSIT and FRENSIT data base managers. An interactive matrix display should be provided for ease of updating.

The justifications for this recommendation are:

- It will reduce the message input requirements by allowing users to default to automatic distribution.
- It appears that a well designed matrix would avoid some of the problems seemingly inherent in operator-created distribution lists. Matrix distribution would be entirely automatic, it would not require memorizing or referencing of a list of distribution codes. The matrix, in at least one aspect, should be more efficient; it would be centrally controlled, thus avoiding duplication problems that would probably occur if every user develops lists that match his own needs.
- Automatic distribution, if well designed, should increase the probability that messages reach the locations where they are needed by reducing the chances of human error that occur in designating addressees or a distribution list for each input message.
- Well designed and reliable automatic message distribution should reduce dependency on SRIs and subsequent risk of system processing overloads.

The feasibility of this recommendation depends on the degree to which distributions can be standardized by a given division according to message type and characteristics and on the relative processing efficiency of the two distribution methods. It is recommended that these two determinants be investigated.

Determine the exact reporting requirements for divisions equipped with TOS. It has been implied in other sections of this document that the center-to-center reporting capability of TOS should be able to satisfy all division-to-corps combat reporting requirements. This inferred capability is based upon the ability of corps to query or SRI the division data base for the information it requires. In part, the inference is correct so long as the data is resident in the data base. However, it appears that there may be other corps data requirements which are not resident in the TOS data base. In the case of FORSTAT reporting, for example, a composite of data from the G1, G3, and G4 must be assembled and loaded into the TOS data base before corps can access it. This type of action may also be required in other areas of the division in order to provide TOS-resident data for corps. If the goal of TOS is to provide

all corps data requirements automatically, then the center-to-center capability and file requirements, both classified and unclassified, must be more thoroughly examined to ensure that the required data items are available. It is suggested that an examination of all corps combat reporting requirements be conducted to determine the essential information required at corps level. Every combat required report, classified and unclassified, for all elements should be reviewed and the appropriate data item requirements extracted to construct the essential information required. Where possible, duplicate or redundant data items should be eliminated. The final list of required data items should be matched against the TOS division data base for availability. Methodologies for incorporating the missing data items into TOS would have to be developed and tested.

Investigate the feasibility of procuring a multiple copy capability for TOS console hardcopy printer. The currently designed printer is a non-impact type that will not produce carbon copies of output messages. It is recommended that the effects of single copy output on command post operations under TOS be investigated and the feasibility of procuring multiple output capability be considered if warranted. It is also suggested that such an investigation examine the feasibility of allowing the operator the capability to specify the number of copies desired and have the printer produce the specified number.

The justifications for this recommendation are:

- The investigation of manual tactical operations center operations indicated that much of the information flow internal to a tactical operations center is accomplished via the distribution of multiple hardcopies of messages recorded over the radio nets. Under TOS, the capability will exist for multiple distribution of TOS inputs and for the transfer of received messages from one console to another. However, it is felt that inter-console transfer of messages might not prove efficient. The messages that are passed between elements within a tactical operations center are typically important ones that require immediate distribution and often require further explanation. Messages transferred between consoles might remain in the console queue for some time before being viewed. Also, this method does not permit explanation and emphasis of the message's meaning and impact.
- The existence of only three consoles at the division tactical command post and at the brigade command post make inter-console transfer of messages less efficient than at the division main command post as these consoles should be very busy just keeping up with the normal inputs and outputs of the elements to which they are assigned. The problem is most acute at brigade which will not have a TOS large screen display device for general viewing of graphical information.
- Battalions will have only one TOS console. It would appear almost essential for them to handwrite additional copies of TOS outputs for dissemination within the battalion command post.

Any investigation of the effects of single copy TOS printer output on command post operations will have to weigh the effects and alternative solutions against the cost and side effects (e.g., noise of impact printer) of multiple copy printers.

Investigate the availability and utility of TOS memory storage at the tactical command post. The tactical command post must operate during periods when the main command post is being relocated or is non-operational. During these periods, the tactical command post will not have access to the DCC. Complete loss of the DCC does not necessarily mean that the tactical command post will have to cease computer operations. The inherent capability in the memory storage of the TCU may be able to provide that support until its data base becomes unreliable due to age. The exact storage and program capabilities of the TOS TCU are apparently not completely known or developed at this time. It is suggested that the DCC/TCU interface be examined to: (1) determine the storage space available to perform tactical operations; (2) determine the interface problems between the DCC and TCU in obtaining and swapping in and out the basic system files required at the tactical command post; (3) determine the feasibility of automatically updating system files resident or being swapped in and out of the TCU; (4) determine the most appropriate methods of sharing computer developed data with surviving echelons; (5) determine the life span of the system files when the DCC becomes inoperative or destroyed; and, (6) develop procedures to return to manual operations should the life span of the files be exceeded.

ANALYSIS SUPPORT

Investigate analysis functions of TOC operations that would benefit from analysis software. The currently planned TOS applications software provides input formatting and storage of tactical data and various means of identifying and formatting data for retrieval from the system but it does not perform any actual data analysis. None of the currently proposed applications programs manipulates tactical data to produce tentative conclusions. In all cases, the actual analysis process remains manual under TOS. It is recommended that the analysis functions performed by tactical operations center elements at the various TOS-equipped command posts be investigated to identify those analysis functions that would derive the greatest benefit from analysis software. Experimental analysis software packages could then be developed for later inclusion in operational versions of TOS. Within the various element descriptions in this document there are several suggestions for specific analysis software routines such as road movement analysis, operational planning, pattern analysis, and order of battle analysis. These areas are ones which this project identified as having the greatest potential for automation assistance. More detailed specific investigations and developmental work will be necessary to prove or disprove the feasibility of any of these suggestions.

The justifications for any recommendation for analysis software are:

- Speed. It may be that the effect of TOS in some areas will be to increase the number of factors or events the analyst can consider in deriving conclusions. This could conceivably slow down the actual decision-making process although the process of obtaining the information for analysis would be shortened. Properly developed and tested analysis algorithm software should be able to consider the same set of data and derive conclusions from it more quickly than the human analyst, especially if the amount of data is sizeable.
- Accuracy. The same argument presented for speed is true for accuracy also. A well designed and tested software algorithm ought to be able to consider many more pertinent factors than a human analyst can in the same period of time. If the algorithm is weighing only pertinent factors, then the accuracy of its conclusions should be increased over those of the human analyst.
- New electronic data collection systems such as SOTAS and RPV are being developed to permit rapid collection of information in large quantities to match the mobility of the modern battlefield. However, if the army command and control system is not able to quickly and accurately analyze this large amount of information, draw correct conclusions, and react in time, then the new collection systems are greatly reduced in value. It would appear that software analysis programs are needed to produce accurate conclusions from large amounts of data in adequate time to respond.

Probably the greatest drawback to software analysis programs, at least in the area of operations and intelligence, is their inherent rigidity. No matter how well they are designed, there will be some deception or novel situation that they cannot handle. For this reason, the outputs of any analysis program must indicate the basis for its conclusions so human judgment can decide its validity.

GRAPHICS

Determine the consolidated display requirements for the division. The specification of dedicated file space for the development and use of graphics displays for tactical operations appears to be undefined or unknown. In projecting the staff utilization of TOS, it would appear that the use of graphics could be very extensive with many overlapping or redundant requirements. With no control, the number of display files used to support all staff users could conceivably be very extensive and cause system overload conditions. To alleviate potential problems, it is suggested that all known TOS user graphics requirements at all echelons be assembled, reviewed, and compared for consistency and redundancy. These requirements, if possible, should be organized into one standardized set of division display files that can be accessed and used at every TOS echelon. Where standardized files are not applicable, the staff users should be permitted to develop unique displays for special purposes, but the file(s) should be eliminated as soon as the requirement is no longer valid.

The construction and maintenance of these additional display files should be monitored and controlled by the system controller and the data base and file managers.

GENERAL

Determine the general training requirements for the TOS system. It would appear logical to assume that the division in garrison would want to use TOS in a training capacity. To be able to accomplish training, TOS should contain an integral training support package which can be used to satisfy a variety of training needs. These needs might include but need not be limited to: command post exercises, system exercises, component training exercises, positional training exercises, division software checkout, and operational readiness evaluations. To satisfy these needs, the training support package might contain or consider:

- A simulation capability. The simulation package required by a division would have to be flexible. Flexibility must be built into activities such as scenario generation as well as in conducting and monitoring the exercise in progress. The basic design of the simulation should be able to accommodate two or more divisions exercising in a corps environment, a division exercising by itself, an element training by itself, or a component of an element receiving exercise training. The system simulation should permit the designer the flexibility to completely simulate any non-participating unit or element, regardless of echelon. Scenarios of this type might be input by magnetic tape or an external computer input but be controlled by the TOS operating system.
- A data reduction capability. To be effective, an exercise training program requires a supporting assessment program. This could be supported by TOS if a data reduction capability were resident in the TOS system. The data reduction program could be used to screen the log tapes and extract the mission essential elements of analysis for the particular mission being conducted. Through analysis support. these data could be refined, analyzed, and assembled in appropriate feedback form for presentation to the participating staff personnel. The data reduction could be designed so as to be used during software checkout to assure operators that the operating system is performing up to specifications. Support algorithms could also be included to provide the capability to conduct trend analysis, comparative analysis, and to measure overall system performance.
- Imbedded training capability. The ability to use the TOS console to post positional training is a distinct advantage. Capabilities exist to develop a program which could be loaded in TOS and used for on-console training of the respective staff personnel in performance of their operational responsibilities. An imbedded training system could also provide evaluation of the results of the training, remedial training when necessary, and maintenance of training conduct records.

It is suggested that the feasibility of such a training support package for TOS be investigated. The investigation should consider the goals and requirements suggested in the preceding paragraphs.

Alter the current TOS hardware assignments. Throughout the element descriptions contained in this document, there are recommendations for changes to the current TOS hardware assignments. The purpose of this suggestion is to summarize those individual recommendations. Figure 2 shows the TOS configuration with the recommended changes. To compare it with the current TOS configuration, see Figure 1 in this volume.

The recommended changes to the current TOS hardware configuration are described below. The appropriate individual element descriptions contain a more detailed discussion of the justifications for these recommendations.

- Add a TOS large screen display device (i.e., IDS) to be controlled by the CM&D element. The existing IDS for displaying intelligence data at the division tactical operations center is in the all source intelligence center (ASIC) van and will be used by the A&P element in their analysis of the enemy situation. Virtually all division tactical operations center elements need some access to a large scale display of the enemy situation. The ASIC van will be too crowded to allow constant in-and-out traffic to view their IDS display. A CM&D display device would be readily available to all elements and could be driven by the basic A&P-generated displays.
- Add a TOS console at the division tactical operations center assigned to the counterintelligence control element. Task data on the CI control element gathered at the investigated division indicate that the primary task performed by this element is in determining "how the enemy sees us." TOS data and data manipulation capabilities affords CI control the opportunity to perform this critical task faster and more comprehensively. Other CI control element tasks also require TOS interaction. The total TOS usage appears to justify a new console dedicated for CI control element use. CI control is not assigned to any console in the present configuration.
- Reassign the DAME and G3 air to the R&S element console. Under the present TOS configuration, the DAME and G3 air share a console with the FSE. This study indicates that the FSE's TOS usage could be heavy and incompatible with that of the DAME and G3 air. The study also indicates that the R&S element's TOS usage should be relatively light and more compatible with the usage made by the DAME and G3 air.
- Assign the NBC element to the FSE console. The NBC element is not assigned to a console in the present TOS configuration. It is felt that the NBC tasks of strike warning processing, fallout prediction and analysis, and vulnerability analysis would be enhanced by using TOS. The TOS tasks performed by NBC are most compatible with those of the FSE. Should the FSE console usage prove too heavy for sharing, consideration should be given to adding an additional console in the operations area.

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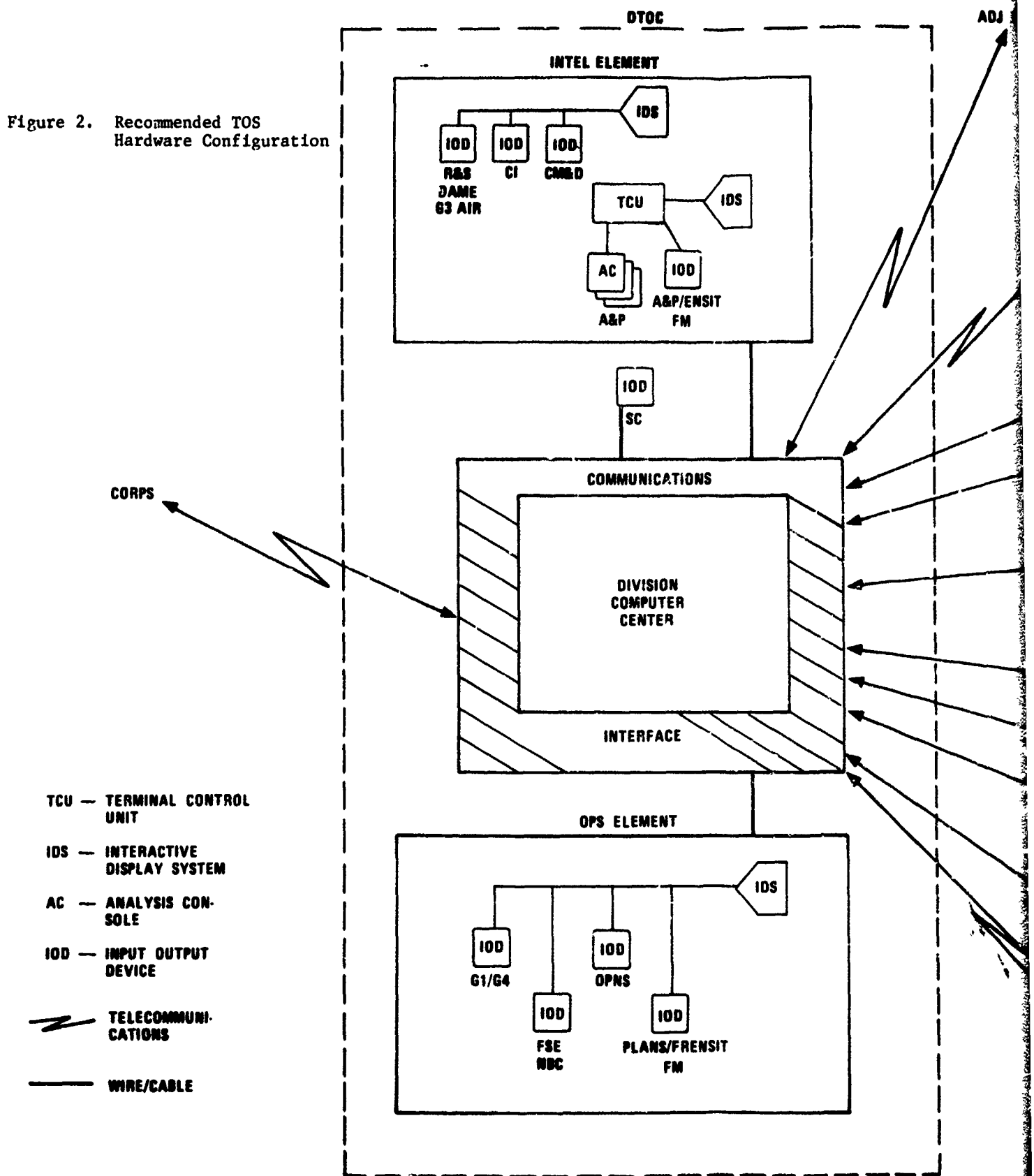
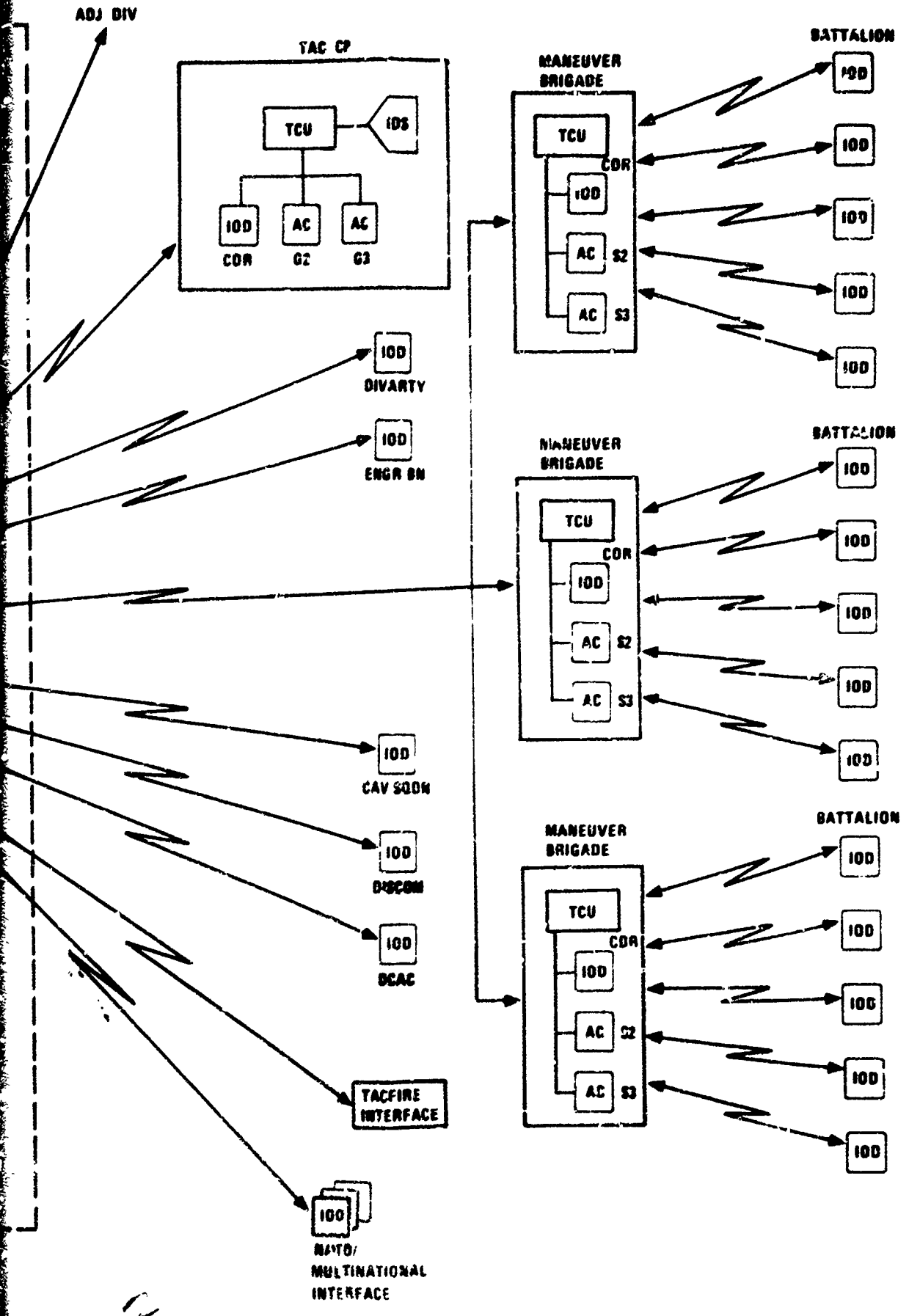
- Eliminate the TOS consoles at the ADA battalion and at the aviation battalion. It appears that these consoles would be used to input asset status. It is felt that status information can be maintained at least as efficiently manually. Also, required coordination with these detachments can be handled more rapidly, efficiently, and with more flexibility via voice communications.

Figure 2. Recommended TOS Hardware Configuration




ADJ DIV
TAC CP
TCU
IDS
IOD
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COR
G2
G3
MANEUVER BRIGADE
TCU
COR
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AC S3
BATTALION
IOD
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DIVARTY
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MANEUVER BRIGADE
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BATTALION
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CAV SQDN
DISCOM
DCAC
MANEUVER BRIGADE
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IOD
AC S2
AC S3
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IOD
TACFIRE INTERFACE
IOD
NATO/ MULTINATIONAL INTERFACE

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A P P E N D I X B

Data Collection Instruments

DATA COLLECTION INSTRUMENTS

The data collection instruments used by the SDC Project Staff to interview FORSCOM division personnel are provided and explained in this appendix. They represent the tools used to interview division personnel to develop a manual baseline of job task information. The interviewees were provided copies of all the forms approximately one week before the interviews.

The data collection package is composed of six basic forms; three handouts for use by the interviewee for reference and responding to questions and three for recording purposes for use by the interviewer. The forms are identified as follows:

- Interviewee - Element Description
  Supervision Rating Scale
  Criticality Rating Scale
- Interviewer - Interviewee Background Data Form
  Position Data Form
  Manual Task Information Sheet

Every interview was begun with a simple statement of purpose for the project and the intended use of the data provided during the interviews. In every case, the interviewees were given an opportunity to review and/or question the data collection forms. The basic use of the forms was as follows:

- Element Description. See attachment 1.

  The element description was provided to the interviewee for information and was the basis for discussing the element's TO&E, internal organization, functions and tasks performed by the element, distribution of responsibilities, and the files and displays used by the element to perform its responsibilities. All other forms relate to and were used in conjunction with this one except the Interviewee Background Data Form for obvious reasons. Element descriptions were taken from the TOS^2 Test 222 manual baseline organization and functions documents. The interviewees were asked to study these element descriptions prior to the interview and make notes concerning where their operations and manning differed from that in the description. Thus, the descriptions provided a means for interviewees to think through their organization and tasks prior to the interview. Attachment 1 is an example of one of the element descriptions.

- Supervision Rating Scale. See attachment 2.

  The scale was designed for use by the interviewees in rating the amount of supervision given and/or received by each position in the element as recorded on the Position Data Forms. The five point scale was constructed in descending order of amount of supervision and ranges from detailed instruction on work procedures to administrative work supervision only.

- Criticality Rating Scale. See attachment 3.

  The scale was designed for use by the interviewees in rating the criticality of each task performed by their elements as recorded on the Manual Task Information Sheets. Criticality was related to the effects of improper performance on mission success. The scale again was constructed using five points ranging in descending order from very critical to no effect.

- Interviewee Background Data Form. See attachment 4.

  The form is self explanatory and used by the interviewer to record the position and element experience of the interviewees. All personnel data, regardless of the number interviewed, was recorded for the element on only one form.

- Position Data Form. See attachment 5.

  This form was used to obtain data on the duty positions associated with an element. One position data form was filled in for every duty position associated with each element. Interviewees were asked to provide the level of supervision a particular position gave and/or received using the values from the Supervision Rating Scale. They also provided general duty statements describing what function(s) the position performed in support of the element. In cases where the interviewee eliminated the position from the element description, no position data form was prepared; conversely where they were added, they were prepared.

- Manual Task Information Sheet. See attachment 6.

  This form represents the major portion of the data collection and was used in conjunction with the element description. One sheet was prepared for every task performed by the element. Tasks not performed were deleted and tasks not included in the element description were added, as determined by the interviewee. The goal of the task sheet was to record who performed the task, what initiated it, what was output, what positions at what echelons were coordinated with, how critical was the task and to collect references and notes that explained task procedures, unusual working conditions, and any other information useful in understanding the task.

The following six numbered attachments contain examples of the handouts and data collection forms.

Attachment 1

Example of Reformatted Element Description Provided Interviewees

COLLECTION MANAGEMENT AND DISSEMINATION

GENERAL. The Collection Management and Dissemination (CM&D) element is attached from the CBTI Company. Its primary function is to coordinate the flow of all intelligence related information for the entire G2 Section and attachments. Two artillery intelligence officers also work with the element.

PERSONNEL.

TITLE	GRADE	BRANCH	MOS	STRENGTH
Intel Ops & Prod Off[1]	04	MI	35A00	1
CM&D Tm Chief[1]	03	MI	35A00	2
Intelligence Ops Sgt[1]	E8	NC	96B50	1
Intelligence Sergeant[1]	E7		96B40	2
Intelligence Analyst[1]	E4		96B10	2
Intelligence Analyst[1]	E3		96B10	2
Total Officer/EM				3/7

EQUIPMENT. None

1. Augmentation from CBTI Co.

FUNCTIONS AND PROCEDURES.

a. Function 1. Assists the G2 in the managing and coordination of the overall collection effort throughout the division.

(1) Develops the collection plan for the division by integrating the collection activities of division assets (air, ground, ground-electronic, HUMINT, and SIGINT) in order to eliminate duplication, avoid nonproductive employment of systems, and insure maximum effective use of collection assets.

(2) Determines intelligence needs relative to mission objectives/ plans and corps directives.

(3) Determines the enemy activities and/or characteristics (indicators) which would satisfy each need.

(4) Determines the specific items of information which by their presence or absence would affirm or refute pertinent indications.

(5) Develops EEI and OIR for approval by the CG.

(6) Determines the priority of need of intelligence.

(7) Determines time limits for reporting collected information.

(8) Develops and maintains the collection worksheet.

(9) Coordinates the collection plans of lower echelons.

(10) Coordinates target acquisition and surveillance plans with the total collection effort.

(11) Assigns collection tasks to intelligence organizations organic or attached to the division.

(12) Consolidates requests from all units and staffs in the command.

(13) Responds to requests for information and collection missions.

b. Function 2. Manages the receipt and dissemination of information and intelligence.

(1) Supervises the processing and evacuation of items listed in the Defense Intelligence Agency Acquisition Manual.

(2) Receives intelligence reports and designates information for dissemination to appropriate echelons.

(3) Keeps key division staff elements informed of significant information and intelligence.

(4) Expedites the flow of combat intelligence information.

(5) Insures that schedule reports are disseminated and contain all information produced during reporting period.

(6) Insures that user time limits are satisfied for negative reporting.

(7) Insures that produced intelligence is disseminated to units per their standing requests for information (SRI).

(8) Insures that intelligence of an immediate nature is disseminated to the TAC CP.

c. Function 3. Coordinates intelligence production to the division.

(1) Supervises the production of intelligence studies, reports, estimates, and plans which are prepared by the A&P, Counterintelligence and Interrogation Sections of the CBTI Company, and other elements of the G2.

(2) Insures that appropriately "sanitized" information is either included or considered in all products of the G2 section.

(3) Evaluates (approves) produced intelligence for dissemination to subordinate, adjacent, and higher units and for presentation via intelligence briefings.

(4) Insures that information return, per collection plan time limits, is being achieved.

d. Function 4. Operates and maintains communication means for the receipt and dissemination of information and intelligence.

(1) Operates intelligence radio teletypewriter communication terminal within the section and supervises its effective use in conjunction with other divisional staff intelligence sections.

(2) Operates the FM radio division/intelligence net.

FILES AND DISPLAYS.

a. Files.

(1) G2 journal (perm).

(2) Intelligence report file (temp).

(3) Requests for information (temp).

(4) Collection requests (temp).

b. Displays.

(1) Intelligence situation map.

(2) Collection worksheet.

(3) Weather chart.

Attachment 2

SUPERVISION RATING SCALE

1. Gives detailed instruction on work procedures.

2. Supervises work activity.

3. Provides detailed guidance about what is expected, reviews all completed products, but does not supervise work activity.

4. Reviews just the more critical completed products or spot checks products, provides conceptual guidance, but does not supervise work activity.

5. Performs administrative work supervision (e.g., scheduling and personnel paperwork) but is not concerned with either work products or procedures.

Attachment 3

CRITICALITY RATING SCALE

1. Will definitely jeopardize the command's mission.

2. Could jeopardize the command's mission.

3. Will affect the element's effectiveness, but will not jeopardize the command's mission.

4. Could affect the element's effectiveness, but will not jeopardize the command's mission.

5. Will have no effect on either the element's effectiveness or the command's mission.

Attachment 4

INTERVIEWEE BACKGROUND DATA FORM

Date: _____

Element: _____

Name: _____

Title: _____

Element Experience: _____

_____

_____

Attachment 5

POSITION DATA FORM

Element: _____

Duty Position: _____

MOS: _____

Immediate Supervisor: _____

Positions Supervised: _____

_____

Level Rating of Supervision Received: _____

Level Rating of Supervision Given: _____

_____

General Duty Statement: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Job Description Document Sources: _____

_____

_____

Attachment 6

MANUAL TASK INFORMATION SHEET

Element: _____ Function: _____

Task: _____ Frequency Estimate: _____

Duty Position: _____ Criticality: _____

Inputs	Outputs	Coordination	Notes

Duty Position: _____ Criticality: _____

Inputs	Outputs	Coordination	Notes

A P P E N D I X C

List of Acronyms and Abbreviations

ACRONYMS AND ABBREVIATIONS

A/C	Aircraft
AC	Analysis Console
ACS	Assistant Chief of Staff
AD	Air Defense
ADA	Air Defense Artillery
ADE	Assistant Division Engineer
Admin	Administration
ADP	Automatic Data Processing
ADSO	Assistant Division Signal Officer
AF	Air Force
AG	Adjutant General
ALO	Air Liaison Officer
Ammo	Ammunition
AO	Area of Operations
A&P	Analysis and Production
AR	Army Regulation
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
ARTINS	Army Terrain Intelligence System
AS	Applications Support
ASA	Army Security Agency
ASARC	Army Systems Acquisition Review Council
ASIC	All Source Intelligence Center
ASR	Army Status Report
Asst.	Assistant
ATI	Artillery Target Intelligence
ATSE	ASA Tactical Support Element
AWOL	Absent Without Leave
BDA	Battle Damage Assessment
Bde	Brigade
bio.	biological
BIR	Battlefield Information Report
Bn	Battalion
CACDA	Combined Arms Combat Development Activity
CAME	Corps Airspace Management Element
CAV	Cavalry
CBR	Chemical, Biological, Radiological
CBRE	Chemical, Biological, and Radiological Element
CBTI	Combat Intelligence
C-E	Communications-Electronics
CEWI	Combat Electronic Warfare Intelligence
CG	Commanding General
Chem.	Chemical
CI	Counterintelligence
CM&D	Collection Management and Dissemination

Co	Company
CO	Commanding Officer
COMSEC	Communications Security
CP	Command Post
CTA	Chemical Target Analysis
DALO	Division Air Liaison Officer
DAME	Division Airspace Management Element
DASC	Direct Air Support Center
DCAC	Division Combat Analysis Center
DCC	Division Computer Center
DCCO	Division Computer Center Operator
DIA	Defense Intelligence Agency
DISCOM	Division Support Command
Div	Division
DIVARTY	Division Artillery
DMMC	Division Material Management Center
DSA	Division Support Area
DSARC	Defense Systems Acquisition Review Council
DT	Development Test
DTG	Date Time Group
DTO	Division Transportation Officer
DTOC	Division Tactical Operations Center
ECM	Electronic Counter Measures
EEFI	Essential Elements of Friendly Information
EEI	Essential Elements of Information
EFLT	Enemy Front Line Trace
ELSEC	Electronic Security
EM	Enlisted Men
Eng	Engineering
ENSIT	Enemy Situation
EOB	Enemy Order of Battle
ESD	Enemy Situation Data
ESM	Electronic Support Measures
ETA	Expected Time of Arrival
EW	Electronic Warfare
EWMXR	Electronic Warfare Mission Execution Report
EWTAM	Electronic Warfare Tasking Message
FA	Field Artillery
FAC	Forward Air Controller
FCL	Fire Coordination Line
FDTE	Force Development Test and Experimentation
FEBA	Forward Edge of the Battle Area
FFLT	Friendly Front Line Trace
FM	Field Manual, Frequency Modulated

FORSCOM	United States Army Forces Command
FORSTAT	Forces Status Report
Frag	Fragmentary Order
FRENSIT	Friendly Situation
FSE	Fire Support Element
FSO	Fire Support Officer
FSOP	Field Standing Operating Procedure
G1	Assistant Chief of Staff - Personnel
G2	Assistant Chief of Staff - Intelligence
G3	Assistant Chief of Staff - Plans and Operations
G4	Assistant Chief of Staff - Logistics
G5	Assistant Chief of Staff - Civil Affairs
GOQS	Generalized On-Line Query System
GSR	Ground Surveillance Radar
GZ	Ground Zero
HF	High Frequency
HHC	Headquarters and Headquarters Company
HID	High Interest Data
HOTPHOTOREP	Hot Photo Report
HQ	Headquarters
hr	Hour
HUMINT	Human Intelligence
ICA	Intelligence Collection Agency
ICC	Intelligence Collection Characteristics
ICM	Intelligence Collection Management
ICMTA	Intelligence Collection Management Tasking Algorithm
ICR	Intelligence Collection Requirement
ICT	Intelligence Collection Tasking
ID	Infantry Division
IDS	Interactive Display System
II	Imagery Interpretation
Info	Information
Intel	Intelligence
INTSUM	Intelligence Summary
I/O	Incoming and Outgoing
IOD	Input Output Device
IP	Initial Point
IPIR	Image Processing Interpretation Report
IPW	Interrogation of Prisoners of War
IRAN	Immediate Air Request Net
k	Thousand
Km	Kilometer

LNO	Liaison Officer
LRRP	Long Range Reconnaissance Patrol
LSS	Line Search System
MIJI	Meaconing, Intrusion, Jamming and Interference
MISREP	Mission Report
MOS	Military Occupational Speciality
MP	Military Police
MSR	Main Supply Route
MTI	Moving Target Indicator
NAI	Named Area of Interest
NATO	North Atlantic Treaty Organization
NBC	Nuclear, Biological, Chemical
NCO	Noncommissioned Officer
NCOIC	Noncommissioned Officer-In-Charge
NCS	Net Control Station
Net	Network
NGLO	Naval Gun Liaison Officer
NLT	Not Later Than
Nuc	Nuclear
OB	Order of Battle
Org.	Organization
OIC	Officer-In-Charge
OIR	Other Information Requirements
OPLAN	Operations Plan
OPORD	Operations Order
Ops	Operations
OPSEC	Operational Security
OT	Operational Test
PDS	Personnel Daily Summary
Perm.	Permanent
PMO	Provost Marshals Office
POEREP	Position Effectiveness Report
POL	Petroleum, Oils and Lubricants
POW	Prisoner of War
RADMON	Radiation Monitoring
RASO	Reconnaissance and Surveillance Officer
RATT	Radio Teletype
recon	Reconnaissance
ROC	Required Operational Capability
ROMAD	Radio Operator, Maintenance and Driver
Rpt	Report
RPV	Remotely Piloted Vehicle

R&S	Reconnaissance and Surveillance
RSR	Resources Status Report
RT	Radio Transmission
RTO	Radio Telephone Operator
S1	Adjutant
S2	Intelligence Officer
S3	Operations and Training Officer
S4	Supply Officer
S5	Civil Affairs Officer
SC	System Controller
SDC	System Development Corporation
Sgt.	Sergeant
SI	Special Intelligence
SIGINT	Signal Intelligence
SIGSEC	Signal Security
SIR	Serious Incident Report
SITREP	Situation Report
SLARS	Side Looking Airborne Radar System
SOP	Standing Operating Procedure
SOTAS	Stand Off Target Acquisition System
Sr.	Senior
SRI	Standing Request for Information
SSN	Social Security Number
SSO	Special Security Office
SWO	Staff Weather Officer
SYSCON	System Controller
Tac	Tactical
tac CP	Tactical Command Post
TACFIRE	Tactical Fire Direction System
TAC IP	Tactical Air Command Initial Point
TACP	Tactical Air Control Party
TARRRS	Tactical Air Reconnaissance Request Reporting System
TC	Training Circular
TCT	Tactical Computer Terminal
TCU	Terminal Control Unit
TD	Tactical Dispositions File
Temp.	Temporary
TER	Terrain File
TM	Technical Memorandum
TO	Task Organization
TOC	Tactical Operations Center
TOE	Table of Organization and Equipment
TOS	Tactical Operations System
TOS^2	Tactical Operations System, Operable Segment
TOT	Time on Target

TTY	Teletype
TWX	Teletype Writer
UOR	Unit Operations Report
USAF	United States Air Force
UTM	Universal Transverse Mercator
VFMED	Variable Format Message Entry Device
VHF	Very High Frequency
Vol.	Volume
WO	Warrant Officer
Wpn	Weapon